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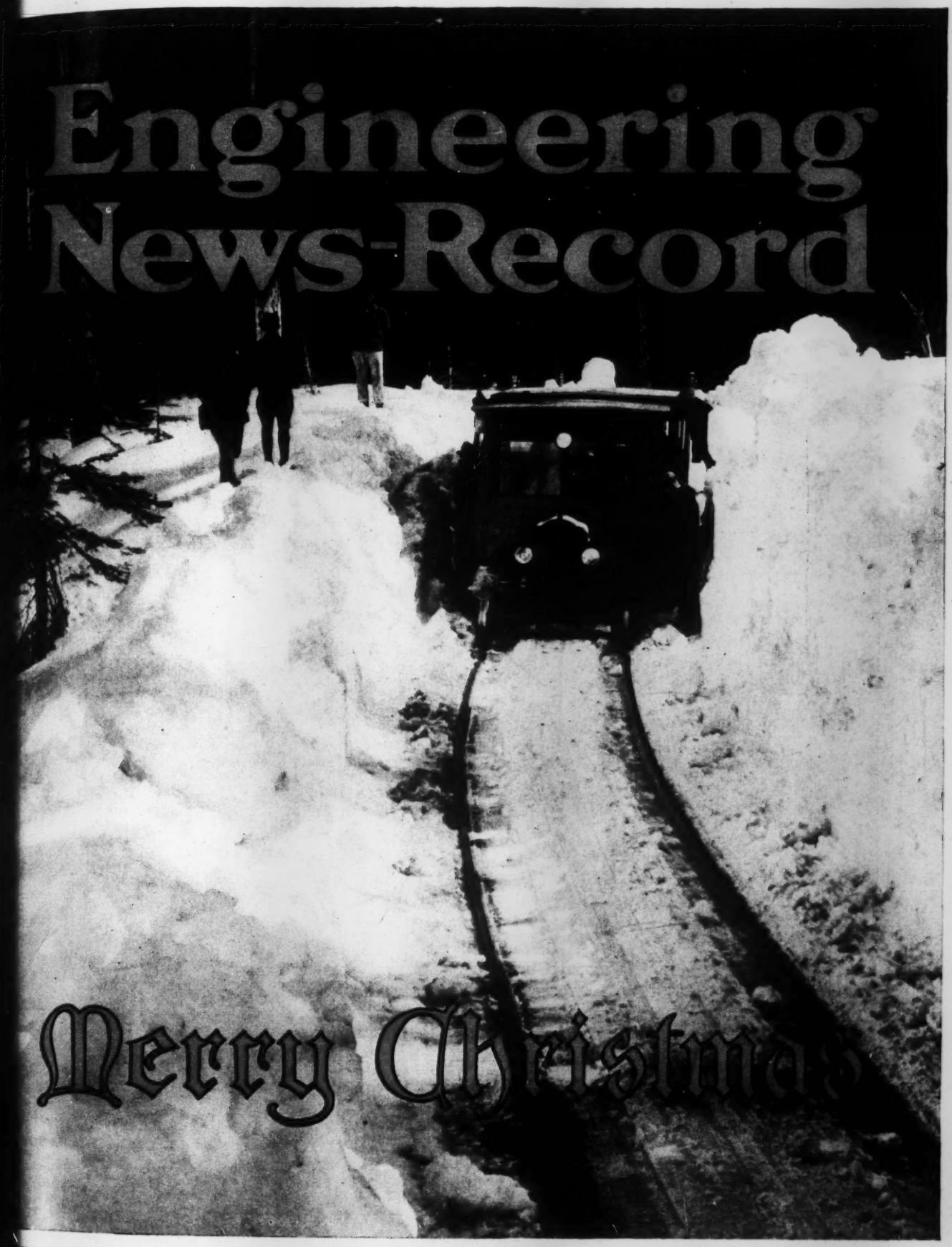

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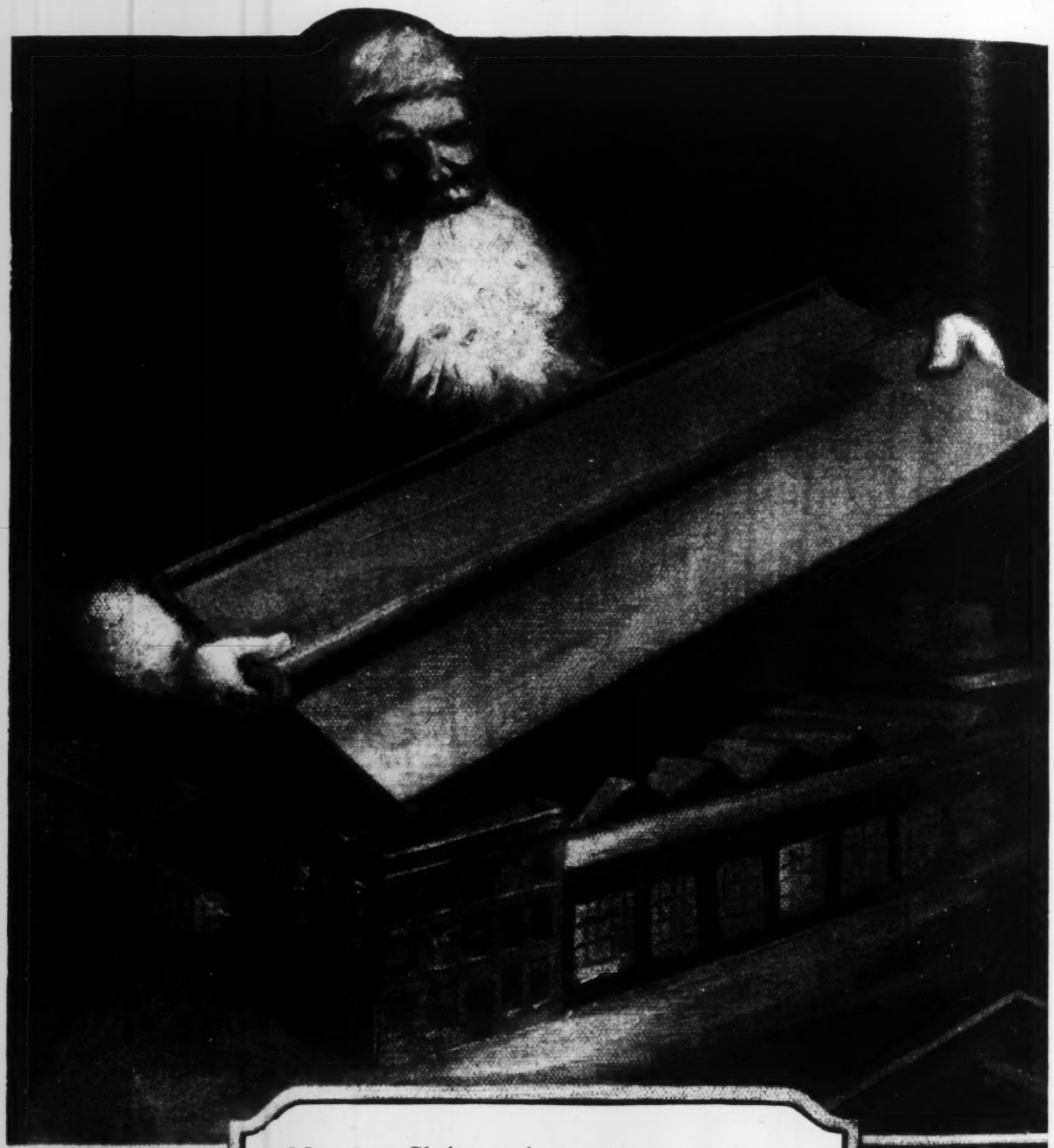

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FRANK C. WIGHT
Editor

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The Christmas Season

THIS is the season of friendliness and peace. Once a year the Carpenter of Nazareth reaches down the centuries to impose these two cornerstones of His faith on the Christian world. No one can escape them for they are all about us, the greatest single evidence of the power of that lone Figure. And so we pause in our drudgery, in our self-seeking, amid the material things of life, to indulge the spirit in that good will toward men that blesses him that gives more than him who doth receive. It is a season of selflessness that paradoxically works back to the benefit of self, as Old Scrooge—the typical anti-Christmasite—long ago discovered. But the spirit of good cheer has this quality, that unless it is spontaneous, unless it is generous, unless it is honest, it becomes as dry husks in the mouth. The selflessness of Christmas is, indeed, the expression of the kind of individualism the world needs. Not the individualism that seeks personal gain, but the individualism that recognizes personal responsibility. To realize that one is a part of the great company that makes our world and that that world will prosper only as each contributes his part, independently in thought and behavior, co-operatively in action—to realize this is to understand best how to promote that peace on earth and good will toward men that is the spirit of Christmas and that might well be the spirit of the year around.

The Writing on the Wall

BRANCH LINE railroads are doomed. The train a day passenger service and the occasional freight can no longer be maintained, since the motor and the paved highway have become available. The writing on the wall has been seen by one road, the Boston & Maine, and it is taking the most sensible step to take care of the situation by going into the motor bus and truck business itself. This is preferable to complete abandonment of service or to the setting up of independent motor lines. The railroads have the overhead organization to finance and operate such motor-bus lines to best advantage, are responsible corporations which can be looked to maintain the service through periods of storm or of financial depression which might put independent operators out of existence, and more important still they have their regular main-line freight and express services and are thus able to relieve the shipper of responsibility for such shipments at their freight house door the same as heretofore. In fact, such motor truck freight operations will probably result in the extension of "store-door delivery" to the farmer's shed. Authority for this wholesale abandonment of branch lines will have to come from the Interstate Commerce Commission, but whether the commission will assume authority over the separate organization which is to take over the operation of the bus lines is an interesting question. So far, in cases where the motor-bus companies were entirely independent of the railroads, the commission has maintained that the Interstate Commerce Act does not give it authority over such bus lines. If this action by the Boston & Maine serves to force Congress to bring the Interstate Commerce Act up to date it will do much toward clearing up a number of absurd situations which have developed in many parts of the country in addition to paving the way for an improved railroad service to outlying rural communities.

Why a Compulsory Stop Law

SOME months ago (Sept. 11, p. 410) we commented on the proposals for a compulsory stop of automobiles at railroad grade crossings and suggested that the importance of the measure as an accident preventive was by no means commensurate with the very active propaganda favoring it. The proceedings of the Hoover Safety Conference at Washington last week add point to the earlier comment. If ever there was a packed meeting the railroads packed this one. Here was one minor point in a long report, a point which had been rejected after fair discussion by the unprejudiced committees of the conference, which was dragged onto the floor time and again and impassionately advocated by successive railroad men who could hardly wait for the prior speaker to sit down. And not a single speaker offered any evidence that what he proposed would increase the safety of highways. Most of the discussion was of the oratorical kind with arm waving and reference to "the life of one little child." A good deal was said about the enmity between the automobile and the railroad. But no one offered to prove that a stop order will save life, and that is the very heart of this question. To be sure, statistics were submitted to show that in some states having a stop law grade crossing accidents have decreased—but they have decreased in some states where this is no such law, so that is not proof and proof is needed. The vehemence with which the railroads

fought this case at Washington lends suspicion to the charges of self-interest in it which have been made. They protest too much. Let them get down to cold facts, if they expect the public to become interested in this proposal. Instead of oratory and calm assumption let them answer the arguments that have been advanced against the proposed law.

Surety Bonding

AT THE annual convention of the Associated General Contractors two weeks hence surety bonding practices will again come up for discussion. Also, if current talk is any indication, this discussion will be peppery. A year ago at the Chicago convention feeling was somewhat moderated by the announcement that a conference committee in which the surety companies and highway officials would participate would in the course of the succeeding twelve months endeavor to arrive at a plan of readjustment. There are two weeks remaining for this committee to function, and until now, at least, its operation has not produced anything which the hard-fisted contractor with a grievance is likely to consider tangible. And the contractors are no more determined to demand a show-down than are many state highway officials. Three weeks ago, at the meeting of the Highway Research Council, two prominent commissioners expressed determination to do their best to eliminate corporate surety bonding from highway work in their states. The grievance of the contractor is not exactly the grievance of the highway official but both appear to be equally provocative of wrath. At least temperate discussion recently has been rare and perhaps this is best on the basis which George Bernard Shaw urges: "The way to get at the merits of a case is to get it argued with reckless bias for and against." Nevertheless it is regrettable that the conference committee could not have arrived further than generalities. Its opportunity was great.

Picking on the Oyster

THE oyster is in an unfortunate position. It never asked to be eaten, much less to have its feeding grounds polluted with sewage. It cannot stand in its own defense. So it lies today, put under suspicion by state and city health officials at a conference in New York City because just now there is an excess of typhoid fever and nothing to blame it on except the defenceless oyster. The wisdom of the warnings against eating uncooked oysters for a time we do not question—although we venture the opinion that a fair percentage of those who sat on the oyster emulated the walrus and the carpenter at the lunch or dinner following. Not many years ago the number of cases of typhoid now being reported each week would have attracted no attention, unless because they were lower than usual. The attention given a relatively few typhoid cases today is a tribute to the health officer and sanitary engineer who together have gone far towards eliminating what was within a decade or two a blot on this country. Although no suspicion of public water supplies have been uttered during the present rise in typhoid, it would be well for every one responsible for the quality of such supplies to examine his defenses lest the old enemy slip in through some poorly guarded point. And some definite facts about the oyster would be worth while.

To Promote Highway Safety

IT IS not necessary to spend any time demonstrating or arguing the seriousness of the street and highway accident menace to our people. Figures only add numerical confirmation to what every one knows—that too many are daily being killed or maimed in going to and fro about their business and pleasure. The automobile, the obvious cause of this new threat to life, is a necessity and we must find some way to accommodate ourselves to its increasing use without allowing it to devour us, but how? That is the problem Secretary Hoover set before the Conference on Street and Highway Safety that met in Washington last week. He recognized that there was no direct and immediate solution; that the evil is widespread and deeply rooted in the physical structure of our civilization and in the mental qualities of our people; but nevertheless the evil is so great and the necessity for its cure so obvious that good judgment dictated some effort be made toward its amelioration.

It can be said with assurance that the conference has accomplished something. It has gathered together a mass of basic data regarding the causes of highway accidents and a mass of useful suggestions as to the cure of the highway congestion evil with its attendant tragic results. Considering the difficulties, the effort has been most successful. No one can hope that a cure is in sight, but one can readily see that a start has been made along the long road which leads to a marked reduction in our highway casualties.

The conference found, as it must have found, that the problem of curing the highway and street accident evils lies along three roads: (1) individual education; (2) governmental control, and (3) engineering changes. It behooves every one who is at all concerned with the bettering of the conditions of life to study this report when it is finally issued and to see how he can advance progress along any one of these three roads.

Obviously, the individual is the foundation stone which must be remade, and remaking individuals is a long and arduous job. Until each person who walks our streets and who drives motors along those streets rises to a higher plane of individual responsibility than the average individual now holds, there is little hope for reducing our accident roll. In government control, possibilities lie ahead in better registration of motor drivers, in more effective enforcement of such laws as we have, and in a development of uniform laws throughout the country.

In engineering changes we have the possibility, though not a very great possibility it must be admitted, of improvements in the automobile itself. More effective control, better braking, less danger of stalling, better lighting, are all things that we will doubtless get as the machine is improved, but on behalf of the manufacturer of automobiles it may be said that he has gone further ahead than have any other of the elements in this problem. The main engineering must be done in our street and road design, partly in the structural design, but more especially in the layout of streets and roads in city and country. A large part of our accidents is due to congestion and congestion is due to the inability of our present thoroughfares to carry the heavy traffic which leads to them. Large sums of money, larger than any ordinary citizen is now willing to admit, must be expended in the near future in open-

ing up new roads, and streets, in developing new centers so that by proper co-ordination of consumer and producer the traffic will be spread instead of concentrated.

How are all these things to be gotten across to the people? It will be slow work and this the conference recognized. It is a matter again of the individual's education, the education not only of the person who walks and rides, but the education of our community leaders who must keep plugging away at the various agencies of reform. Co-operation is needed, co-operation between individuals, co-operation between city and state, co-operation between the states themselves, and co-operation between the states and the federal government.

But most of all, we believe, there is needed to be placed upon this problem the gradual and increasing impress of the engineer, for, after all, the education of the individual to safer traveling is a matter of evolution. The fit will survive and the later generations will learn by the experience of their ancestors, but to aid the individual in his learning, to make his passage through our communities more safe, even to him who will not learn, requires the work of the engineer.

Unfortunately, at the conference at Washington the engineers' work was little stressed. The committee reports stress it. If one reads them one finds that down at the bottom, the hope of the future is in engineering improvement; but of the 500 or more men and women who were present at each of the sessions only a few were engineers and they, as usual, were not vocal. The distinguished chairman, an engineer, emphasized when he could the importance of the engineering necessities in traffic safety. But the insurance men, the safety men, the railroad men, the automobile manufacturers, the presidents of women's clubs, the police inspectors, the mayors and the social workers who were present were the ones who talked and the ones who forced on the outward conscientiousness of the conference, at least, the importance of a number of the less important details which will go into the producing of a safe street or highway.

The engineer should take heed of this fact. The Street and Highway Safety Conference is to become a permanent organization in all probability. It will meet every year to take stock of progress. It will have a permanent skeleton organization which will be reaching out over the length and breadth of the country to impress on those in power in the various communities the ways and means of promoting safe highways. The engineering societies should get in touch with this organization. They should be in touch with its branches or with the local authorities in their own communities and they should, while co-operating in every way with the educational regulatory improvements which are necessary to promote safety, insist and keep on insisting upon the fundamental importance of engineering improvements, for in the end the great money that is to be spent and the great advantages that are to be gained will come from the work of the engineer. This work is fundamental to the relief of highway congestion, which brings the accident and death tolls the Washington conference sought to reduce. That this congestion is equally responsible for an economic loss is obvious also to engineers; their remedies therefore have an additional claim to attention that the others do not possess.

Problems such as this one are not settled overnight or by fiat. The solution is the slow process of time and effort. But the Safety Conference has made a good start; it has set up a rule of conduct and a code of procedure which now needs only general appreciation and organized effort to make effective.

A Courageous Proposal

OF GREAT significance for the future is a bill just placed before Congress, which promises to reshape the entire reclamation policy. It proposes aided settlement, in the line of Elwood Mead's views. The government would select settlers, give them adequate agricultural aid, and provide low-interest loans to furnish the money which the farmer needs in converting the raw land into a farm. He is to pay interest both on such loans and on the original cost of the irrigation work. Careful provision is made to prevent land speculation—an obvious necessity, long recognized as such but always given up as hopeless. For the present, the aided settlement plan in to be applied only to selected areas on each of the new irrigation projects. While these areas will be only small parts of the respective projects, they will be large enough to give a thorough demonstration of the success or failure of the plan. It is clear that, when once shown to succeed, the new plan will quickly spread over the full area of each project.

The logic behind this proposed legislation is simple: All the reclamation projects which are now being proposed (some of them already authorized, tentatively) will cost two or three times as much to build as previous ones, and yet will have no high productivity; if the old ones do not pay the farmer, how can he possibly expect to get along on the new ones? The answer is, only by avoiding some of the big losses of the old system, most of them lying in the great expense of getting started, due to high interest rates demanded by private lenders, and lost motion and lost time in developing a going income-producing farm.

It is not necessary to add that there are many skeptics on the subject of aided settlement, perhaps more skeptics than advocates. But the old system is a failure, so far as future reclamation is concerned. There can be no possible warrant for building a single additional reclamation project on the go-as-you-please plan. Besides, even if the new projects were to cost no more than the old and were to be fully as successful, the old plan ought to be recognized as wrong. Under that plan the farmer paid no interest, but the nation at large had to pay the interest for him, and so subsidized him. We do not believe that it is necessary or desirable to subsidize farming; but if any farmers are to be subsidized, let all farmers benefit equally—let the plan be applied to all parts of the country and not merely to a few favored districts. Dr. Mead's aided settlement system, then, is entitled to a fair trial, in the hope that it may solve the problem of encouraging Western agriculture without degrading reclamation to the level of pork-barrel trafficking. The Mead system's chance for success would be still better if the bill provided for a board or a commission to administer the loans to settlers, instead of having the Secretary of the Interior handle this money direct. A government administrative bureau is not a proper institution to act as banker or pawnbroker to its wards.

Carbon Monoxide Under Traffic In Liberty Tunnels

Composition of Tunnel Air Found to Agree with that Calculated from Road Test Data Obtained Before Construction—Marked Effect of Air Current Induced by Motion of Vehicles

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THE AMOUNT of ventilation required for the Liberty Tunnels at Pittsburgh was calculated by the designing engineer from data obtained by the Bureau of Mines during 1920 and 1921, when the amount and composition of exhaust gas given off by automobiles and trucks at various speeds on level and 3 per cent grades was investigated (see Report of New York State Bridge and Tunnel Commission, 1921, pp. 91-140). In those tests, samples of the undiluted gas were taken from the exhaust pipe and analyzed. The volume of exhaust gas and of carbon monoxide emitted per minute was then calculated from the analyses of the gas and gasoline, and the amount of gasoline consumed. This calculation was made on the basis that all of the carbon taken into the engine in the form of gasoline was in turn discharged through the exhaust pipe in the form of carbon-containing gases consisting of carbon monoxide (CO), carbon dioxide (CO_2), and methane (CH_4). Since carbon monoxide is the only poisonous or *asphyxial* constituent (this term is now used in place of "poisonous," which is not correct from the standpoint of the physiological action produced by carbon monoxide) of consideration in automobile exhaust gas, the ventilation of highway tunnels must be based on the total volume of CO given off. Therefore the average volume of CO given off by various types of automobiles and trucks at various speeds was determined for use in designing the ventilation requirements for such tunnels, so that under the worst possible conditions of traffic congestion there could be no possibility of danger to health or safety.

Since completing that investigation, the Bureau of Mines has desired to make a comparison of the data obtained therefrom with those obtained under the conditions of actual traffic passing through a tunnel. The completion of the Liberty Tunnels, five months prior to completion of the ventilating plant (now operating), afforded this opportunity, and the results of a comparison are reported herein.

For this opportunity the bureau is greatly indebted to A. D. Neeld, engineer in charge of construction of the tunnels, and to A. C. Gumbert, R. C. Cain and James Houlahen, commissioners of Allegheny County, who entered into a co-operative agreement with the bureau to open these tunnels to limited traffic under chemical control, pending completion of the ventilating equipment. The Bureau of Mines took charge of analyzing the air at regular intervals to insure that at no time the traffic exceeded the natural ventilating ability of the tunnels. The expense of these tests was carried by the county.

TABLE I—CARBON MONOXIDE IN TUNNEL AIR AND IN BLOOD OF OBSERVERS

Direction of cars from Station 6 to Station 1 in east tunnel.
Direction of cars from Station 1 to Station 6 in west tunnel.

Tunnel	Air Analysis in Tunnel Air—Stations						Blood Analysis and Symptoms				
	I	II	III	IV	V	VI	Number of Men	Average Per Cent Saturated With CO	Duration Exposure Hr.	Duration Exposure Min.	Symptoms
Test I											
East	0.041	No	0.018	0.014	No	0.013	3	17	1	20	No symptoms. Canaries at Station 1 and 2 showed no symptoms.
West	0.016	sample	0.020	0.028	sample	0.043					
Test II											
East	0.076	0.050	0.047	0.033	0.023	0.022	7	21	1	20	Two men reported slight symptoms. Canaries O. K.
West	0.017	0.021	0.033	0.055	0.066	0.077					
Test III											
East	0.029	0.025	0.020	0.019	0.012	0.008	8	18	2	30	No symptoms. Canaries O. K.
West	0.011	0.016	0.022	0.025	0.030	0.025					
Test IV											
East	0.039	0.043	0.027	0.021	0.013	0.012	8	22	1	55	Two men reported slight, but not distinct symptoms
West	0.011	0.016	0.028	0.042	0.047	0.048					
Test V											
East	0.033	0.023	0.018	0.018	0.014	0.005	7	14	3	0	No symptoms.
West	0.018	0.031	0.020	0.012	0.005	0.005					

Station 1— 567 ft. from north end of tunnel.
2—1,567 ft. from north end of tunnel.
3—2,567 ft. from north end and approximately 300 ft. north of shaft.
4—2,222 ft. from south end and south of shaft.
5—1,222 ft. from south end of tunnel.
6— 472 ft. from south end of tunnel.

Test Arrangement—The twin parallel tunnels (Fig. 1) are 5,888 ft. long; each has a cross-sectional area of 468 sq.ft. and a total volume capacity of 2,755,584 cu.ft. They are connected at evenly spaced distances by 11 man passageways, which are closed at each end by a steel door. At approximately mid-point of each tunnel are two ventilating shafts, the upcast opening directly into the roof, and the downcast into a nozzle parallel to the upper periphery of each side, the distance between the nozzle and the shaft opening being approximately 75 ft. At the time of these tests the shafts were tightly closed with boards covered with roofing paper. The only other openings into each of the tunnels are the end portals, which were also closed at this time with a tightly fitting wooden bulkhead having at the bottom and near the center of the roadway an opening 9x12 ft. for admitting the automobiles.

In general, the tunnels as arranged for the tests constituted two huge gas chambers, which the machines entered through one of the bulkhead openings and left through the other. These openings were not closed after each succeeding machine, but were closed at the end of each test, previous to sampling the atmosphere within.

The general procedure of making the tests was to allow a predetermined number of cars to pass through the tunnel, after which the doors were closed and the samples of tunnel atmosphere quickly obtained. The total number of cars permitted for each test was that

number which on the basis of the calculations previously mentioned would produce an atmosphere of approximately 4 parts of CO in 10,000 of air, the maximum safe concentration of CO for an exposure of one hour.

In Test I (passenger cars) and Test II (trucks), both of which will be discussed later, the cars were solicited from public-spirited citizens, and prior to the start of the test were assembled in procession outside the portals, so that after the test had started a continuous and fairly evenly spaced traffic could be maintained. In the remaining three tests (III, IV, and V) this prearrangement was not made, the tunnels being merely opened for public use, the traffic depending on what happened to come along. In all cases an accurate record was made of the number and type of car. in addition to this, air velocity data taken with anemometers were recorded throughout the test, and temperatures and humidity readings were taken.

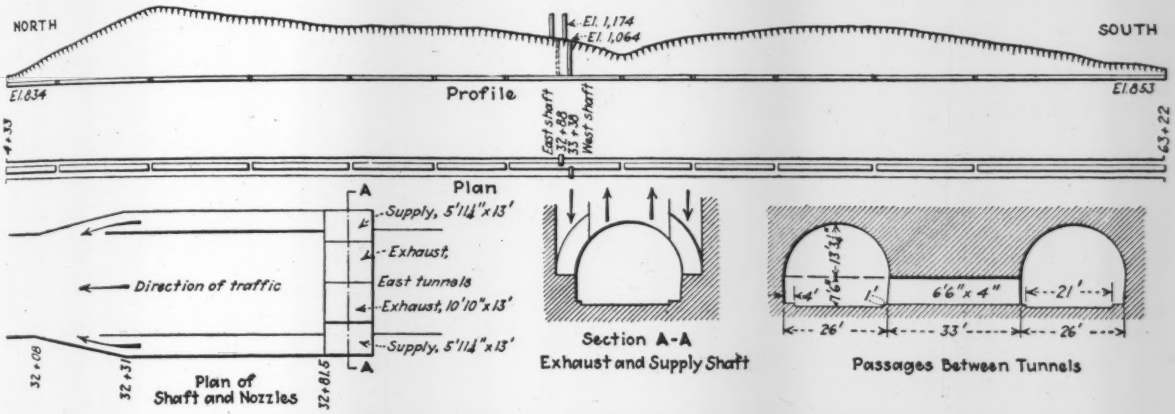
The gas samples were taken at the stations and positions shown in Table I. The blood of all observers who remained in the tunnel for the duration of the test was examined for CO content. Analyses of the gas samples were made by the pyrotannic method. (The pyrotannic acid method for the quantitative determination of carbon monoxide in blood and air by R. R. Sayers, W. P. Yant and G. W. Jones, Bureau of Mines Reports of Investigations, Serial No. 2486, June, 1923. Also noted in Public Health Reports, October 5, 1923, pp. 2311-2330.) The results of these analyses are given in Table I.

Calculated Concentration—The CO concentration was calculated from the average values obtained in the 1920-21 road tests, which are given in the accompanying table (p. 1024).

It is unfortunate that speeds comparable to the data at hand from these previous tests could not be maintained in the tunnel, but the tendency among drivers was towards speeding, and it was impossible to keep the touring cars and light trucks under 25 to 30 miles per hour. In Test I this was most successfully done. In view of the speeds being greater than those for which the data were obtained in the road tests, it was necessary to extrapolate for the higher speeds. In this it will be noted that the volume of CO produced per hour in nearly all cases increases with the speed, but on the other hand, at an increased speed the car will be in the tunnel a shorter time. In fact, the two factors almost compensate each other.

The calculated concentrations in the tunnel for the number of vehicles in the tunnel tests are given in Table II, together with the actual concentrations obtained by analysis of the tunnel atmosphere.

The latter were in all cases taken as the highest found for a single cross-section. Although it was desired to make the tests as nearly as possible without ventilation and loss of gas, the movement of the cars set up considerable air motion in the direction the cars were going, except in Test V, where in the west tunnel the natural wind velocity opposing traffic was greater than that resulting from the cars. However, in this test the traffic per unit of time was low. It is quite probable that an increased number of cars would have set up a movement in the direction of traffic, this



VENTILATING SYSTEM OF LIBERTY TUNNELS, PITTSBURGH

TABLE II—COMPARISON OF CALCULATED AND ACTUAL CARBON MONOXIDE CONCENTRATIONS IN LIBERTY TUNNELS

Tunnel	Duration of Test Period (Min.)	Approx. Speed, (M.P.H.)	Number and Type of Cars: 5-Passenger Cars	7-Passenger Cars	Trucks Up to 1½ Tons	Trucks 1½—3 Tons	Trucks 3½—4 Tons	Trucks 5 Tons and Over	Total Number of Cars	Total Volume of CO Liberated Cu.Ft.	CO in Tunnel Air By Calculation	CO in Tunnel Air By Analysis
Test I, Jan. 12, 1924												
East	60	25	111	86	4	1	..	1	203	1,046	0.038	0.041
West	60	25	114	85	..	..	..	..	199	1,010	0.037	0.043
Test II, Jan. 17, 1924												
East	56	15	4	2	13	40	4	52	115	1,242	0.046	0.076
West	56	15	5	3	12	..	36	56	112	1,289	0.048	0.077
Test III, Jan. 21, 1924												
East	135	30	69	36	38	7	2	..	152	724	0.027	0.029
West	135	30	53	54	47	6	..	6	166	888	0.032	0.033
Test IV, Jan. 24, 1924												
East	120	30	151	72	40	20	6	10	299	1,539	0.056	0.043
West	120	30	173	73	26	5	..	13	290	1,422	0.052	0.048
Test V, Jan. 28, 1924												
East	180	30	271	89	27	4	6	7	404	1,824	0.067	0.033
West	420	30	212	72	75	15	1	23	398	2,118	0.078	0.031

having occurred in all previous tests. Just how much of the gas was lost through the openings in the bulkheads is difficult to estimate, because measurements of air velocity indicated not a progressive uni-directional movement with the cars, but often a reversal, indicating a back-slipping of the air previously set in motion resisted by the bulkhead. However, the net result was in the direction of traffic, which is further substantiated by the gradual variation in the average results of analysis (Table II) obtained for each cross-section. This gradation is entirely indicative of forward air motion and dilution with air from the entering portal. Accordingly, the section having the highest concentration would be the least contaminated, and the concentration value for the entire tunnel if no dilution or ventilation had occurred must have been at least this great.

CARBON MONOXIDE PER HOUR, CUBIC FEET AT 65° F. AND 29.92 IN. HG., FOR VEHICLES LOADED TO HALF CAPACITY

	Speed, miles per hour					
Class of Car	6	10	15	20	25	30
1. 5-passenger	...	46	61	73	(85)	(95)
2. 7-passenger	...	71	105	137	(155)	(168)
3. Trucks up to 1½ tons	...	60	72	94	(110)	...
4. Trucks, 1½ to 3 tons	68	104	104	(130)	...	...
5. Trucks, 3½ to 4 tons	93	148	131	(160)	...	...
6. Trucks, 5 tons and over	110	152	(195)	...	...	...

Figures in parenthesis ( ) are extrapolated values.

Discussion of Results—With the exception of Tests III and IV, the agreement between the results obtained by analysis and those calculated is seemingly very good.

In Test II, the amount found by analysis far exceeds that calculated. The large 5-ton trucks used were loaned by contractors, and the drivers, for whom these tests were a sort of gala occasion, continually drove in rhythmic acceleration and at an unsteady speed, which would result in numerous backfires and a much greater consumption of gasoline and liberation of CO. Also, the trucks were adjusted for heavy winter hauling, and quite likely the gasoline-air mixture was very rich.

Test V is not comparable with the others as too much gas was lost from the east tunnel through high wind velocity in the direction of the cars, and also the duration of the test was much longer than the previous tests. In all probability the time was a great deal longer than that required for a cross-section of maximum concentration to travel the length of the tunnel. The conditions for comparison in the west tunnel were even worse, as for the first and only time during these the air velocity due to high winds exceeded at times that produced by the cars, and the section of maximum concentration was repeatedly shifted. This reversal of direction, being changeable, allowed for incoming air to alternate between the ends of the tunnel, consequently markedly lowering the concentration of CO. Also, the duration of test in this tunnel was 7 hours, which allowed too much time for the escape of gas.

In all tests the blood of the observers showed the presence of CO in amounts in agreement with what would be expected from exposure to CO in concentration such as were found by the air analyses.

Conclusion—This investigation in the Liberty Tunnels verifies the values for the liberation of carbon monoxide as previously obtained by calculation from analyses of the exhaust gas and the amount of gasoline consumed in road tests, and supplies fundamental data for calculating the ventilation requirements of vehicular tunnels.

Discharge of Irrigation Siphons in California

Tests of 8- to 12-Inch Asphalt-Coated Riveted Steel Pipes Under Low Heads Show High Friction Losses

By L. Standish Hall
Civil and Hydraulic Engineer, San Francisco, Calif.

TESTS that were made in the summers of 1920 and 1921 on riveted steel siphons used for the irrigation of reclaimed land in the Sacramento-San Joaquin delta in California should be of interest as showing larger friction losses than are ordinarily found in pipe of the character used on these installations. The Sacramento and San Joaquin Rivers enter this region by tortuous channels inter-connected by meandering sloughs, which divide the area into many large and small islands. These islands are flat areas ranging in elevation from a few feet above sea level to 10 or more feet below. Practically the entire area has been reclaimed by levees and is under cultivation. Since a large portion of this territory is below the normal level of the water in the stream channels, it is possible in most cases to siphon water over the top of the levees for use in irrigation.

TABLE I—RESULTS OF TESTS OF IRRIGATION SIPHONS IN THE SACRAMENTO-SAN JOAQUIN DELTA, CALIFORNIA

Date	Test No.	Diameter In.	Length Ft.	Mean Head Ft.	Mean Measured Discharge Sec.-Ft.	Mean Velocity Ft. per Sec.	Value of K_2
Sept. 1920..	7	12	116.5	5.50	5.78	7.36	0.041
	14	12	115	4.66	5.25	6.68	.042
	17	10	114	2.72	2.67	4.90	.037
	19	10	150	2.65	2.86	5.25	.023
	5	8	120	5.00	2.37	6.80	.026
	21	8	109	4.46	1.81	5.17	.049
	30	8	118	5.50	2.02	5.77	.046
Aug. 1921..	7	12	116.5	5.82	6.27	8.00	.035
	11	10	143	5.01	3.72	6.82	.029
	12	10	136.5	6.16	4.19	7.69	.028
	10	10	124.5	5.55	3.73	6.84	.037
	5	10	152	7.22	4.64	8.51	.024
	2	10	139	6.25	4.07	7.47	.032
	1	10	151.5	6.08	4.03	7.39	.028
	11*a*	8	130	4.84	2.18	6.25	.028
	6	8	136	4.77	2.14	6.14	.028
	4	8	134.5	6.11	2.46	7.05	.027
	35	8	107	5.79	2.35	6.62	.038
	1	6	115	6.32	1.33	6.76	.026
						Mean..	0.033

Each siphon has two 15-deg. bends separated by 20 ft. of straight pipe at the top of the levee.

The discharge measurements described in this article were made on a number of such irrigation siphons located on one of the large islands in the delta. The siphons range in diameter from 6 to 12 in. and are from 100 to 150 ft. in length. Two 15 deg. bends separated by 20 ft. of straight pipe are used where the siphons pass over the tops of the levees. The small plates used in making the pipe are riveted longitudinally and transversely in lengths of about 3 ft. The pipe is coated inside and outside with asphalt.

The discharge measurements of these siphons were not made with an extreme degree of refinement, but it is believed that they were sufficiently accurate to indicate the losses to be expected in installations of this type. Measurements were made by means of submerged orifices set in the ditches below the outlet of the siphons. The ditches were from 2 to 4 ft. wide. Portable orifices were used, made of thin steel plate with openings ranging from ¾ to 2 sq.ft. in size, depending on the size of siphon tested. Gages were set in the river near the entrance to the siphons and in the ditch just above the submerged orifice for the purpose of

recording the head on the siphon. As the delta is within the zone of tidal fluctuation, the head varied slightly over 4 ft. during the day. The measured head varied from 1.35 ft. to 9.1 ft. for individual measurements on different siphons. Sufficient measurements were made at each test to cover the full range of head to be normally expected at each siphon. All discharges for each test were computed by the usual formula $Q = AC\sqrt{2gh}$, using a value of C of 0.65. This value of C was adopted because there was some suppression of the contraction especially near the bottom of the opening.

The computation of losses in head through the siphons was made by the formula recommended by Professor King:

$$H = \frac{v^2}{2g}\left(1 + K_o + K_1 \frac{L}{d^{1.25}}\right)$$

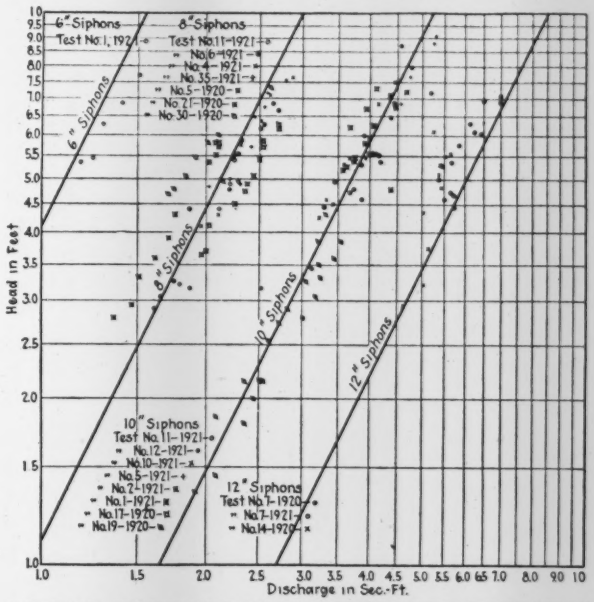
where

H = total loss in head in feet
V = velocity in feet per second
g = acceleration due to gravity
K_o = coefficient of loss at entrance
K_1 = coefficient of friction loss in pipe
L = length of pipe in feet
d = diameter of pipe in feet.

The value of K_o was assumed as 0.78 for this type of entrance and the value of K_1 then could be computed. An additional coefficient for loss due to bends was originally assumed, but as this was small it was considered an unnecessary refinement in view of the large variations found in the computed value of K_1. The coefficient K_1, therefore, covers all losses except that due to entry. The diameter and length of siphon, together with the mean head, mean measured discharge, mean velocity in siphon, and computed value of K_1 for each test, are shown in the table. The values of the head, discharge, velocity, and coefficient K_1 in this table are the averages of from six to ten measurements made on the siphon tested. The computed value of the coefficient K_1 varies from 0.023 to 0.049, the average value being 0.033. These values of K_1 are larger than might be expected for riveted pipe with asphalt coating, the usual value of this type of pipe being from 0.015 to 0.020. Using the value of 0.033 for K_1, the discharge of the various size siphons under varying heads for average operating conditions was computed by means of the formula given above, and these results were used in determining the average discharge of the various sizes of siphons.

Under similar conditions of head the discharge of siphons of the same size varies considerably between individual siphons. These variations are largely due to air in the pipe or obstructions, usually sticks, lodging in the bends of the pipe. It is apparently impossible to overcome these difficulties. Air in the pipe may be caused by improper installation of the siphon, making it impossible to remove all of the air with the priming pump. Such conditions, when they occur, can usually be remedied. However, when a siphon is allowed to run a considerable length of time, air gradually accumulates at the highest point in the siphon and if this is not removed by occasional repriming, the siphon will eventually stop operating. Because of this fact, the average discharge of siphons under operating conditions is apt to be slightly lower than that obtained by using a value of K_1 of 0.033, since when these tests were made all air was first removed.

The lodging of sticks in the bends of the siphons also causes fluctuation in the discharge. There is much debris floating in the river, especially near the banks, so that it is practically impossible to keep such material out of the siphons. Siphons are frequently allowed to run until they become so clogged due to such obstructions that it becomes necessary to take them apart and remove trash at the bends in the pipe. On several occasions during a test, it was found that a siphon would show a marked decrease in discharge between certain measurements. This was due to sticks lodged in the pipe. However, the tests that have been made cover a representative number of siphons and, it is believed, indicate, as accurately as probably can be expected, the average discharge through such pipes under normal operating conditions in the Delta region.



AVERAGE DISCHARGE OF RIVETED STEEL IRRIGATION SIPHONS IN SACRAMENTO-SAN JOAQUIN DELTA

Measurements made in 1920 and 1921. Average discharge based on the use, in a standard pipe formula, of a single discharge coefficient of friction loss for all siphons. Test results, as indicated by plotted points, vary with practical operating conditions.

Water-Supply and Drainage Work in Corsica

Corsica, off-shore six hours by fast steamer from Nice on the Mediterranean, is one of the backward French possessions. The eastern shore of the island, by a law of 1911, was authorized to spend 11,500,000 francs for the supply of drinking water to the various cities and towns and the draining of marsh land. Drinking water has been given to various isolated communities, at an expense, to date, of 1,369,000 francs. Additional work is in progress which will result in a supply to a half dozen more communities, the water to be taken from the rivers Tavono and Travo and filtered. In all this drinking water supply will cost 6,861,000 francs. Drainage of marsh land and the regulation of certain rivers and mountain streams will cost 4,500,000 francs. Another section of this latter work, comprising the districts of Porto-Vecchi, Aleria and Fiumorbo, and the installation of an adequate pumping system will call for the utilization of an additional 25,000,000 francs when voted by the Ministry of Public Works.

Exhibition Hall of High-Strength Structural Steel

Saving of 10 Per Cent in Weight of Steel Frame Obtained by Use of Metal One-Third Stronger Than Soft Steel

A NEW TYPE of steel of increased strength has been applied in the construction of a new exhibit building of the Leipzig Fair in Germany. According to an article in *Der Bauingenieur* of Oct. 25, G. Hulsmeier, engineer of the Lauchhammer Works, at Riesa, which built the structure, states that the new steel is about one-third stronger than ordinary soft structural steel, yet has but slightly decreased ductility. The Leipzig building department authorized the designers of the structure to use unit stresses 30 per cent greater than allowable for ordinary structural steel.

Typical sections of the building for which the new steel found its first use are shown in the illustration herewith. The steel central structure, as shown, is continued laterally by lower reinforced-concrete structures.

The middle bay is a continuous-frame structure, rigidly anchored to its foundation piers so that the columns are substantially fixed at the base. At the top of each column the frame is extended outward in the line of roof girder of the side bay, to a hinged joint, where the side-span roof girder is carried. Where these girders rest on the piers of the outer walls they have expansion bearings; all lateral forces are resisted by the frame of the central bay. Each bay contains a longitudinal runway for a 22-ton traveling crane. The spacing of columns and transverse frames is about 31 ft., but the outer crane runway girders have a span of half this amount being supported by reinforced-concrete brackets at intermediate points. The main columns

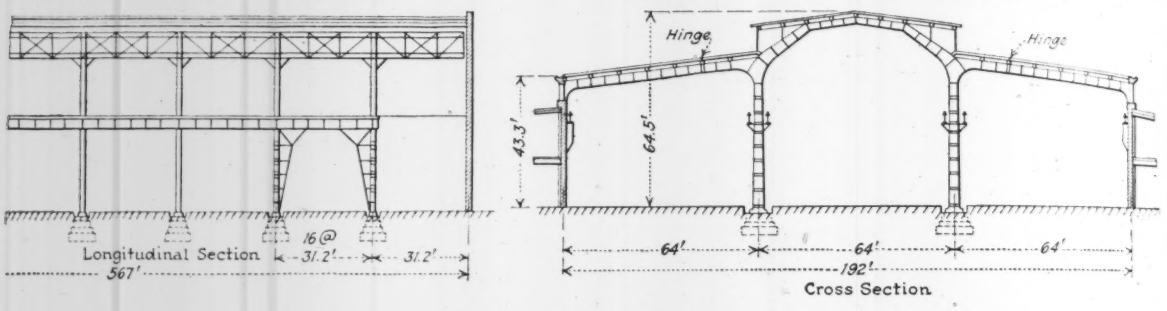


FIG. 1—SECTIONS OF EXHIBITION HALL 9 AT LEIPZIG

Test figures for the new steel are quoted as follows: Ultimate strength, 78,500 lb. per sq.in.; yield-point, 44,000 lb. per sq.in.; elongation, 20 per cent. The material is straight carbon steel. The original motive for its development, it is stated, was the fact that the open-hearth structural steel produced at the Riesa plant regularly showed higher strength than competing structural steel, which suggested the idea that further development of the strength properties of the material, if feasible, would permit using higher working stresses. Extended experiments were therefore made by the company in conjunction with Professor Gehler, of the Testing Laboratory of the Dresden Technical College, to determine the most efficient type of steel that could be produced under normal metallurgical procedure. The result was the metal of properties as given above.

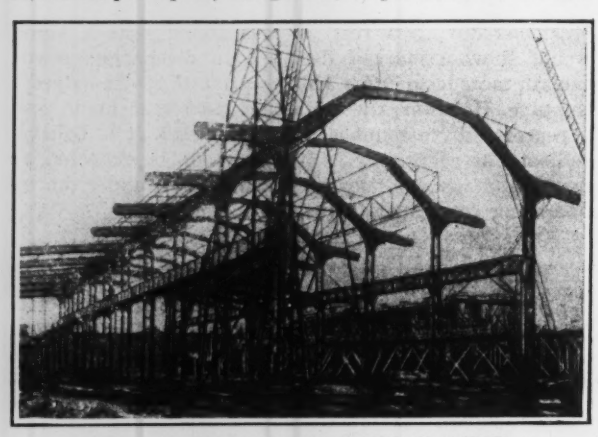


FIG. 2—ERECTION OF CENTRAL AISLE

below the level of the roof-girder brackets consist of two separate columns connected by rigidly attached struts. Two transverse expansion joints divide the 567-ft. length of the structure into equal parts. In each section, longitudinal bracing is provided by one panel of portal bracing. The roof construction is reinforced hollow tile covered with composition.

A total steel weight of 585 tons is contained in the framing and purlins. This is stated to represent a saving of 70 tons over a corresponding structure built of normal structural steel. The special steel, however, was used only for main stress-carrying sections, while tie and lacing members, fillers, etc., were made of ordinary steel.

Reconstruction Work in North France

Of all districts of the devastated regions of North France where destruction during the World War was greatest Peronne holds the banner for reconstruction. There are 77 communes in the district. There were excavated 4,680,000 cu.m. of debris and 38,680,000 cu.m. of trenches and underground works were filled in. All work of this nature has been completed except in the region of Thiepval. There have been repaired 2,983 dwelling houses and 2,511 farm buildings. There have been rebuilt 4,771 farm buildings and 4,072 dwelling houses. There are 1,368 dwelling houses and 524 farm buildings in process of repair and 4,212 dwellings and 2,334 farm buildings in process of construction. In the city of Peronne itself there were destroyed 4,143 houses, of which 250 have been repaired, 638 rebuilt, with 174 in course of repair and 382 in course of construction. At Albert there were 2,200 houses damaged or destroyed; 1,635 are rebuilt or repaired.

Observations on Rock Boring Mollusks in Concrete

Analyses Show Acid Used by Borers in Cement Mortar at Los Angeles Harbor—Aggregate Unlike Rock on the Beach is Immune

BY W. R. SADLER AND D. E. HUGHES
Chief Chemist, Los Angeles Harbor Dept. Civil Engineer, San Pedro, Calif.

SINCE ROCK boring mollusks (*Pholadidei Penita* Conrod) were found in 1922 and 1923 in old concrete cast around wooden piles in Los Angeles harbor, there has been frequent reference to the discovery and much discussion as to the extent to which these borers might attack concrete in sea water. However, little or no additional information on the subject has been brought out since the discussion of the Los Angeles harbor case by Dr. C. A. Kofoid in the 1923 report of the San Francisco Bay Marine Piling Survey. Discussion of the activity of the borers in Los Angeles harbor appeared in *Engineering News-Record*, March 15, 1923, p. 499, and April 5, 1923, p. 635, and in *Transactions*, Am. Soc. C. E., Vol. 86, p. 469. Although there are a few reports from widely separated points that the borer has been found in concrete the authors have thus far no definite information as to the kind of concrete attacked or the aggregate used.

Since the presence of borers in Los Angeles harbor concrete became known, the authors of this paper have been observing their operations and give, in the following, a summary of tests, analyses and conclusions to date in so far as these are believed to be of interest to the civil engineer.

Quality of Material Attacked—The borers in Los Angeles harbor were found to be confined to concrete jackets which had been cast around wooden piles some sixteen years ago. These damaged casts were found on both sides of the main channel from the foot of 4th St. as far north as the end of the old wooden wharfs, a distance of about a half mile. The water here normally shows little, if any, fresh water dilution and may be considered as "sea water."

The jackets in which the borers were found were made mostly of a mix consisting of one part of cement to three parts of sea sand, though a few were richer, and some might even be rated as neat cement. The sand from five casts combined gave the following analysis:

45 per cent retained on 80 mesh screen
42 per cent retained on 100 mesh screen
8 per cent passing 100 mesh screen

In a few instances individual samples ran as follows:

All passing 10 mesh screen
6 per cent retained on 50 mesh screen
52 per cent retained on 80 mesh screen
21 per cent retained on 100 mesh screen
17 per cent retained on 200 mesh screen
4 per cent passing 200 mesh screen

The jackets showing high compression tests had from one to five borers per square foot, while jackets showing low test had from four to ten borers per square foot. The sample showing the highest breaking point was the first concrete in which the borers were found and the part destroyed had quite a few borers in it, and was apparently as accessible to them as the poorer grade of concrete. The crushing strength of 3-in. cubes of these damaged casts of 1:3 mix varied from 500 to 3,300 lb. per square inch. Those which were in fairly good condition ran well over 1,500 lb. per square inch. These would certainly be classed as fairly good concrete mortar, especially when it is remembered that the mix was made from sea sand and had been exposed to the action of sea water for about 14 years. So well preserved was some of the concrete, even to its outer surface, that the entries to the borer holes within were yet no larger than pin heads, and in a few cases these were even smaller than the shank of a pin.

In most cases the borers were found between the mud line and a point 20 in. above it. In no case were they found in concrete higher than 4 ft. above mean lower low tide. Nor were any found in a concrete having a coarse aggregate, whether broken stone or gravel, that was foreign to the immediate locality, even though these types of concrete were found adjacent to borer infested casts made from sea sand. However, the concrete of sea sand without added aggregate did contain an occasional small piece of black stone, harder than slate, which had been in the sand and in some instances the borers had encountered them and had removed portions of them as was revealed by finding in the sides of perforations smooth, dark new surfaces ¼ in. square or more, which were flush with the wall of cement and sand adjoining them.

It is important to note that along the beach either live Pholas or perforations made by them in the past may be found in every variety of rock that is native to this locality, including sandstones of every degree of coarseness and hardness, limestones, shales, indurated clays and other stones of which some are hard enough to scratch window glass. Also that the perforations extend without visible offsets through portions of stone differing widely in coarseness and hardness, and even in kind, for they cross veins of other materials.

Equally important is the fact that thus far after diligent search by many, no attack has been found on any material, other than neat cement, brought to Los Angeles harbor from a distance, whether granite, andesite, gravel, broken stone, brick, or terra cotta, though all these have been equally exposed in the immediate vicinities of the damaged pile jackets.

Indications of Chemical Action—In view of the foregoing, tests were made to determine whether the borer's action is mechanical or chemical. An examination of a number of borers showed that in some cases the borer was so curved and twisted that the greatest possible rotation could not exceed eight to ten degrees. The shell is very rough and laminated, showing that there is very little, if any, rotary movement. It is also softer than some of the stones which are penetrated. The head of the borer is not always spherical or symmetrical, in fact a symmetrical head is very rare indeed. Many live borers were found on which the forward end of the shell was not yet formed, and in which the organic part apparently at work was extended considerably in advance of the shell. In fact, the forward part without shell often exceeded half the length.

It was also observable in many samples, both in concrete and in rock, that material immediately surrounding the ore was altered in appearance to a depth varying from $\frac{1}{32}$ to $\frac{1}{8}$ in. In a few cases of freshly made holes the thin, concentric layer which had been

discolored was found by mechanical tests to have lost part of its cohesive strength. From these facts and because of the snugness with which the borer, after his shell has formed, fits into his hole, the theory that its action is purely mechanical was abandoned.

Presence of Carbonic Acid Shown—The next step was to determine if there was some chemical secretion from the borer itself. In order to do this a number of borers were carefully removed from their native habitat and placed in containers of sea water where they could continue their normal functions both on concrete and without the concrete. In both cases controls were run in order that checks on the solutions and any changes which might occur could be noted. In both cases there was a very material increase in the carbonic acid content of the water in which the borers were placed and practically no increase of this acid in the check solutions. The borers which were allowed to remain in the concrete were active for about ten days while those removed from the concrete either died or became dormant after two days.

There undoubtedly are one or more normal secretions from the borers but the only chemically active secretion which we have been able to isolate up to date is the carbonic acid which is, of course, a well-known solvent for a great many classes of material. This action is very slow but would certainly be rapid enough to meet all the needs of the borer in its normal state.

From these tests and observations it is concluded that the boring action is accomplished by chemical rather than by mechanical means. The authors incline to the belief that as small particles of insoluble material are loosened they are passed through the alimentary canal of the borer and out at the posterior end. Based on observations thus far the authors are not certain that a stone which appears immune from attack in one locality is necessarily so everywhere else, for it is conceivable that borers in different localities may have been endowed with different powers to make their habitats in the materials at hand; and, therefore, that a stone riddled in one locality would endure in another.

However, in view of the foregoing the authors believe that good concrete containing everywhere an aggregate of gravel, or of broken stone differing in kind from that on the beach, together with any sand, or else containing only silica sand if part of it is coarse, will be immune from the attack of borers in Los Angeles harbor.

Ancient Water-Works Found in India

Traces of water conduits believed to be five centuries old have been reported from India, according to a cablegram to the New York *Times* based on an account in the London *Times* of the results of excavations made by officers of the Indian Archaeological Department at Harapha, in the Punjab, and at Mohenjo Daro, in the Sind. The earliest previously known traces of Indian civilization dated back only 2,500 years. According to Sir John Marshall, Director General of Archaeology in India, "5,000 years ago the peoples of the Sind and the Punjab were living in well-built cities and in possession of a relatively mature civilization, with a high standard of art and craftsmanship and a developed system of writing." The remains brought to light include houses and temples, massively built of burnt brick, and provided with well-constructed water conduits covered with marble slabs.

Waves Do Serious Damage at Rio de Janeiro

Peculiar Combination of Tide and Ground-Swell Sends High Waves Over Sea Walls and Scenic Drives

BY GEORGE SCHOBINGER
Rio de Janeiro, Brazil

ALTHOUGH Rio de Janeiro by its natural situation appears to a certain extent protected from the open sea, and has a wonderful, almost land-locked harbor, it is at times exposed to a peculiar combination of high tides and ground-swell which is locally called a "resaca." These resacas, recurring every few years, have in the past caused great damage at various points along the sea-walls, and have put out of service considerable portions of the scenic sea-drives of the city.

The accompanying map, Fig. 2, shows the general geographic and topographic layout. The points which

FIG. 1—WAVE BREAKING OVER SEA-WALL, RIO DE JANEIRO

in the past have been peculiarly exposed are marked with stars *A* and *B*. The first of these, on the Praia do Flamengo (Flamengo Beach) is within the bay, and to one who examines the site it is hardly comprehensible that such powerful seas can occur there. At that point, in 1909, there was such a heavy tidal wave that it flooded all the streets in the vicinity, although they are about 2 meters above ordinary sea level. In 1921 there was a great resaca, which although it did not destroy the sea-wall, ripped up great areas of concrete walk and pavement along the Praia do Flamengo. As shown in Fig. 1, the breaking of the waves against the wall was very spectacular, throwing great masses of water fifty to a hundred feet in the air. The pounding of these tons of water falling on the pavement was tremendous.

In Copacabana, the Avenida Atlantica improvement was completed in 1920; credit for this goes to the dean of Brazilian engineers, Dr. Paulo Frontin, according to inscriptions on a monument on the Avenida. Portions of this sea-wall were badly damaged by the resaca in 1921 and were entirely rebuilt in 1921-1922. The section in front of and north of the Copacabana Palace Hotel, however, is part of the original wall built in 1920, which was not attacked by the 1921 resaca but succumbed to the waves in October of this year. This is the wall shown in the photographs Figs. 3 and 4, taken in October, 1924.

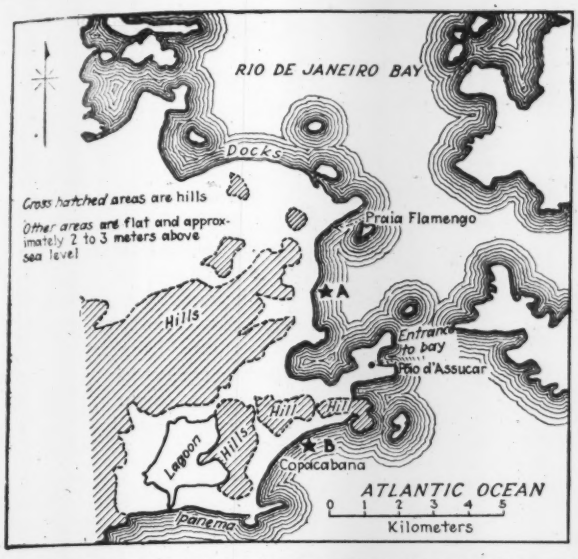


FIG. 2—POINTS OF DESTRUCTIVE WAVE ACTION IN RIO DE JANEIRO HARBOR

Between Oct. 19 and 21, 1924, there was a series of exceptionally high tides (full moon was Oct. 12), accompanied by a heavy ground-swell. Along the entire length of the Copacabana drive (Avenida Atlantica), where there is ordinarily a beach at least 100 to 200 ft. wide, the sea reached, and in many cases broke over, the top of the wall and into the drive, in some cases flowing to the opposite sidewalk. The effect was very different at various points of the beach; on a length of over a kilometer it built up the beach to a depth of 2 to 5 ft., and cast great quantities of sand into the driveway, covering it from 2 to 6 in. At other points it removed from 5 to 10 ft. of sand, and there, notably in front of and north of the Copacabana Palace Hotel, it undermined the foundations of the wall, causing the sand backfill to bleed out. This resulted in the caving in of the sidewalk and portions of the pavement. The wall soon breached, and a section about 50 yd. long fell,

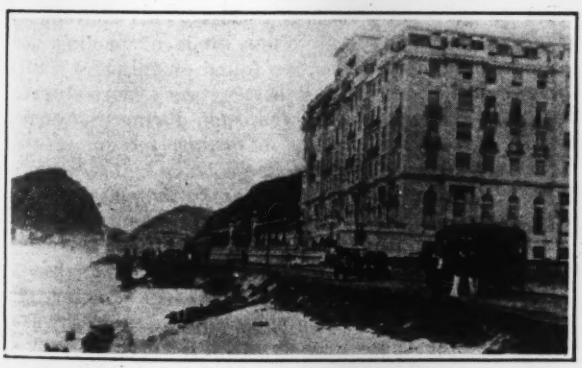


FIG. 3—DAMAGE AT BEACH OUTSIDE THE HARBOR
Avenida Atlantica, Copacabana Beach showing breach in sea-wall. Remains of old beach protection uncovered.

exposing the roadway to erosion by the sea. Other portions of the concrete foundation, apparently of very poor quality, were removed bit by bit by erosion, and along several stretches the rubble masonry wall was standing on small pilasters which resisted erosion, with the sea sweeping freely under the remaining portions of the wall. These sections fell subsequently, and now about 300 to 400 meters of roadway are exposed to the sea.

At some points, see Fig. 3, remnants of old beach protection work have been exposed, indicating that the present losses are merely the reclaiming by the sea of its old territory.

Some fears have been expressed for the safety of the large hotel building, but from observation on the ground it hardly seems likely that its foundations are seriously endangered, although some exceptional seas might damage the front of the property.

Incidental damage consisted in the destruction of many hundred square meters of the mosaic sidewalk pavement typical of Rio, the "pedras portugueses," which are laid without binder on a sand bed. They were ripped out and scattered broadcast over the entire street pavement.

Some points of interest to engineers are the very slim section of the sea-wall, which for a height of 10 to 12 ft. has a base of only 2 ft. One long section was moved

FIG. 4—REMAINS OF SEA-WALL, AVENIDA ATLANTICA

bodily outward several feet, and just beyond it one was moved inward. The portion of the sea-wall rebuilt in 1922, apparently with better and deeper foundation and heavier section, was not injured.

During the succeeding thirty days very little repair work was done to protect the roadway, and the high tides of November 11 again caused some erosion. There was, however, no ground-swell and the net result was a filling in of the beach to a slightly higher level and the loss of a few square yards of pavement.

Connecticut Valley Regional Planning Board

The Connecticut Valley Regional Planning Board, which is to report to the Massachusetts Legislature by Jan. 7, includes a landscape engineer and a civil engineer in its membership, in accordance with the terms of the act creating the commission. The civil engineer is Frank P. Cobb, city engineer of Chicopee, and the landscape engineer is Harold H. Blossom, landscape architect of Dedham and Boston. The commission was appointed by the governor, succeeds the Connecticut Valley Park Commission, and is to make a study of the "subject-matter of the report" of the commission created in 1923. The act creating the board provided that it should be composed of seven members, of whom two should be professional men, as above stated, and three should be chosen, one each, from the membership of the county boards of supervisors of Hampden, Hampshire and Franklin counties. The life of the commission ends when its report is submitted.

Reminiscences of Winter Construction in British Columbia

Many Bridge Piers and Other Concrete Structures on Grand Trunk Pacific Railway Constructed in Sub-Zero Weather, Often at Reduced Cost

By A. M. Bouillon
Civil Engineer, Chicago, Ill.

THE ARTICLES on winter construction published in recent issues (*Engineering News-Record*, Oct. 2, 9, 16 and 23, 1924) are of more than ordinary interest to me because of the great amount of winter work done under my supervision, including foundations and steel superstructures of large steel bridges, while district engineer on construction of the Grand Trunk Pacific-National Transcontinental Ry. in Canada. I may here say that our heating plant and precautions to insure good concrete during very severe winter conditions on construction of the bridges in the west, particularly the North Saskatchewan River bridge near Edmonton, were as nearly perfect as could be provided and although those particular jobs were completed fifteen years ago, the methods used then could hardly be improved upon today under the same winter conditions.

From April, 1906, to October, 1919, about fourteen years, the author of this article was a construction engineer on the Grand Trunk Pacific Ry., first in the Canadian western provinces and then in Quebec, and in that period helped in the building of scores of winter structures. The views, some of them fifteen years old, show actual winter operations. The text is the comment of one whose experience in winter construction is equaled by few.—Editor.

On the Battle River steel viaduct, 2,800 ft. long, the substructure of which consisted of 2 large abutments, 104 pedestals and 2 large river piers, fully 50 per cent of the concrete work was done during the winter, also some of the excavation and pile-driving.

On the South Saskatchewan River bridge near Saskatoon most of the excavation for the river piers was done during the winter, including the building of cofferdams which required cutting through ice from 2 to 3 ft. thick, also fully one-third of the concrete was placed in winter. This bridge was 1,500 ft. long and the foundations included eight piers and two abutments.

On the North Saskatchewan River bridge near Edmonton the substructure of which was built mostly by the railway company direct (the work having been taken away from the contractors), work on the substructure during the last years of its construction was carried on night and day so as to insure completion by the time that the track would reach the bridge site, this event having been scheduled for the following spring together with delivery of the superstructure steel. This bridge was designed with four large river piers supporting deck trusses over the river portion, with steel viaduct approaches at both ends. The four big piers, to be built of mass concrete, were to rise to a height of about 100 ft. above the low water level and to extend 40 to 50 ft. below it, making the total height average between 140 and 150 ft. The quantity of concrete in each pier averaged about 4,500 cu.yd., all mass concrete.

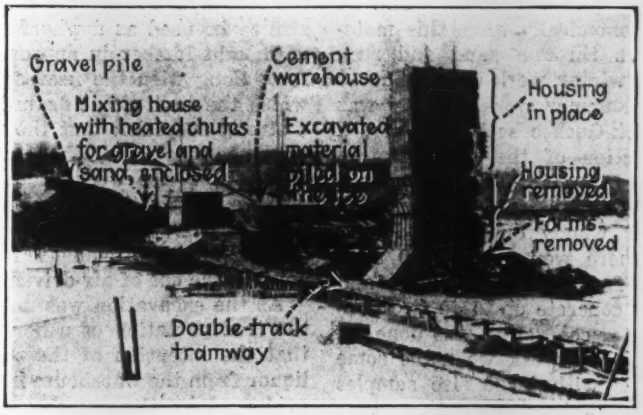
About two-thirds of the total concrete on this job was placed during winter, and this included nearly all of the concrete on three of the large river piers. Not only concreting, but also the construction of cofferdams, driving of sheet piles and round piles, and excavating for the river piers, was carried on by night and day shifts during one of the coldest winters recorded in that district, temperatures during nights at times dropping to 40 deg. below zero and even lower, the lowest recorded at the bridge site during our construction reaching 68 deg. below zero.

These conditions had, of course, been anticipated and our preparations included precautions that would insure the carrying out of the work under any degree of cold that could be expected and we were not delayed by the weather. Our direct control of this work enabled us to keep detail cost data of the job and it was interesting to note that the cost of our winter work averaged less per item than similar work done during the open water season, the extra cost due to heating the materials, housing and heating the piers and the mixing plants being more than offset by losses that resulted from sudden floods occurring at unexpected as well as expected periods during the open water season, when booms of logs from up-river camps would break loose and carry away our caissons and cross-river tramway. Also, the great convenience afforded by the ice permitted much more economical delivery and handling of materials to and around the piers and this meant quite a saving on the job. Other factors in our favor were the low cost of fuel, as we obtained our coal from a nearby mine, the haul over the ice permitting much heavier loads, delivered in shorter time than could be done on the bank roads. This convenience, of course, applied to all other kinds of hauling done around such work. Also, we found on this and similar jobs, that the men worked better, being more cheerful, healthier, and better contented, than during the warmer period with its handicaps of rains, mosquitoes and occasional extreme heat, their efficiency being increased from 10 to 20 per cent, according to the class of work.

I might also cite the case of the Pembina bridge located west of Edmonton. Most of this substructure was likewise built during the winter, although very little was done by night shift. However, concrete was poured on this job during days when the temperature dropped lower than 40 deg. below zero. The cost of heating was likewise offset by the same advantages mentioned above, namely, the ability to haul heavy loads by sleds over the winter roads, in this case cement having to be hauled 75 miles by team from Edmonton, gravel and sand about 2 miles over the river ice, and coal, which was obtained from a seam conveniently exposed along the river, costing only the price of hauling it on the ice.

Other work under my supervision that was done during the winter included erection of steel super-

Construction Operations Carried on During Severe British Columbia Winters



ABOVE—HOUSING AND FORMS FOR PIERS

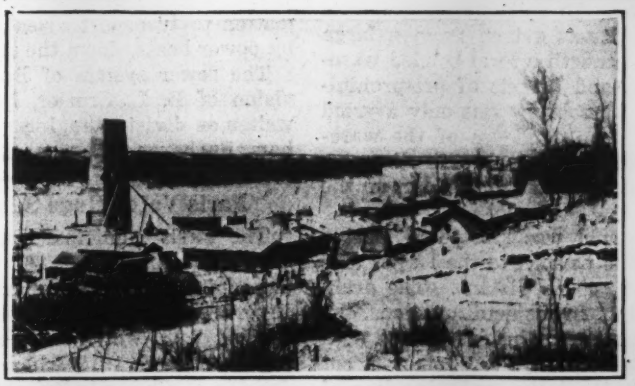
Ice aided transportation and plant placement on North Saskatchewan River bridge. Note the derricks, one at each pier, set on timber towers 44 ft. above the ice and guyed together across the river. With 80-ft. masts these derricks reached 124 ft. above ice level. They had 80-ft. booms. Each pier 50 ft. below ice level and 200 ft. above ice level contained 4,500 cu.yd. of concrete.

BELOW—WINTER BUILT CONCRETE PIER

Winter concrete as clean, smooth and sharp-edged as any laid in summer on the North Saskatchewan River bridge.

BELOW—BATTLE RIVER BRIDGE SUBSTRUCTURE

Over 16,000 cu.yd. of concrete in 104 pedestals, 2 abutments and 2 river piers, placed in winter.



BELOW—CONCRETE DESTROYED BY FROST

Freezing occurred when heating apparatus broke down for a few hours one very cold night on pedestal 52 of the Battle River bridge.

ABOVE — WINTER CONSTRUCTION CAMP

Men in winter camps more efficient, more contented, more cheerful and healthier than in summer.

BELOW—FIRE HAZARD OF WINTER WORK

Fire destroyed housing and forms for pier 13 of North Saskatchewan River bridge. Note the pitting of the concrete opposite the horizontal bracing where the fire was most intense.

structures, construction of large arch culverts of mass concrete, excavation through muskegs which could be handled better and more economically when this material was frozen; excavation through sand and rock cuts on which, as I recall, winter work cost about 10 to 20 per cent more than summer work. There was also, on the New Brunswick-Quebec sections where I was later transferred, erection of the usual station buildings along 830 miles of line including the shops and engine house at eight division terminals, many of which buildings were built wholly or partly during winter. On this section there were about 100 steel bridges ranging in length from 40 to 4,000 ft., and many arch culverts of mass concrete up to 40 ft. diameter, on many of which winter concreting was done.

During suitable stages of our work we made some interesting field experiments with large size samples of concrete (as used in our structures) that were allowed to freeze and thaw. We also investigated the effect of various degrees of heat on concrete from the fresh mixture to the setting stage, so as to enable us to determine the safe limits for heat as well as for cold, or, in other words a range of safety within which concrete would set at as near ideal conditions as possible. This study opened quite an interesting subject and showed us the danger of overheating concrete.

Bootlegging Engineers Just Miss Putting Over a Good One

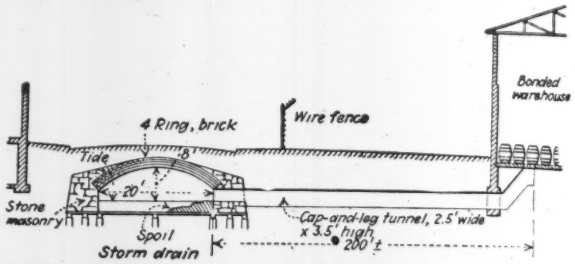
By Milton J. Ruark
Division Engineer of Sewers, Baltimore, Md.

THAT the sewers in large cities are sometimes used as a retreat for "underworld" characters, as was alleged of the sewers of Paris in Victor Hugo's famous "Les Miserables," has been demonstrated by an incident which recently called for the service of the sewer maintenance forces in Baltimore. In spite of an elaborate system of guards, a tunnel was driven from a large storm drain to a point underneath a local bonded warehouse where nearly a thousand barrels of pre-prohibition liquor were stored and a robbery was only averted by the chance discovery by an employee of the warehouse company that a hole a few inches in diameter had been pierced from below in the first floor of the warehouse.

The drain where the tunnel was started is located in a public street which runs parallel to the longer side of the warehouse and about 45 ft. distant. The drain is 20 ft. wide and 8 ft. high, in inside dimensions, the arch being formed of five rings of brick overlain with sturdy haunches of rubble masonry. A hole was cut through the side of the drain at the springing line of the arch, approximately 200 ft. upstream from the mouth, the point selected being in the portion of the drain where the bottom is below mean tide in the Patapsco River and where there is nearly 2 ft. of water at all times. Work was evidently started from a light-draft boat, in which it was a simple matter to enter the drain from the river except in times of exceedingly low tide.

The walls of the drain having been cut, a tunnel approximately 2.5 ft. in width and 3.5 ft. in height was excavated at right angles to the drain, across the warehouse yard to a point nearly 50 ft. distant underneath the floor of the warehouse. Here the tunnel turned upward sharply and ended in a small square chamber directly below the first floor of the building. The excavated material was deposited in the drain at the tunnel mouth to form a bank which was of sufficient size to be used as a wharf. The tunnel was timbered with light lumber in approved cap-and-leg style, which fact, along with the neat and workmanlike manner in which the wall of the drain had been cut, gives rise to a strong suspicion that the work was accomplished by workmen who were either unusually skilled in this class of work or else were under the direction of someone who was thoroughly experienced. The grade and alignment of the tunnel were excellent and there were a number of bits of evidence found in the hole that would point to the use of air-driven tools on the tunnel.

As the excavation was not of sufficient size to admit the transportation of a barrel of liquor, it is assumed that the intention of the tunnelers was to siphon the liquor from the warehouse into their passage. This was evidenced by the presence of a quantity of new hose which was found extended ready for use when the work was discovered.



TUNNEL DRIVEN BY BOOTLEGGERS FROM BALTIMORE STORM DRAIN TO BONDED WAREHOUSE

Careful waiting and thorough investigations have failed to reveal any of the perpetrators of this skillful piece of engineering work. It is noted, however, that had the scheme for removing liquor been brought to an operation basis, it would have been a comparatively easy matter to transport sizeable quantities of contraband by power boats, down the sewer and into the harbor.

The sewer system of Baltimore is under the supervision of B. L. Crozier, highways engineer, with the writer as division engineer of sewers, and R. S. Wickham, in charge of sewer maintenance.

Paris Votes Huge Sum for Flood Protection

The Paris municipal council has just voted for the expenditure of 120,000,000 francs for the protection of the capital against the periodic overflows of the Seine River. In October the gage at the Pont d'Austerlitz marked 7.32, which was less than a meter below the high water of 1910 which caused millions of francs' damage. Choisy-le-Roi, above Paris, and Courbevoie, below, are to be included in the new scheme. Independent of the all-inclusive plan the lower Seine will be dredged that it may more readily carry off the flood and the Marne above Paris will henceforth pass the bulk of its flood water into a diversion canal outside the walls of Paris. The study and experiment already made has cost the sum of 2,200,000 francs. The diversion of the Marne will cost a billion francs, which is the more to be remarked in that it will serve no useful industrial or commercial purpose as now foreseen. In addition, 120 million francs is to be expended by the Prefecture of the Seine in the construction of two reservoirs in the Morvan and one in Champagne for the conservation of Seine water which feeds Paris when at flood time the whole flow is turned around Paris.

One of a Series of Articles on the Details of Design and Layout of Different Types of Industrial Buildings

Office and Exhibition Building for Furniture Industry

Great Concrete Building at Chicago Provides Offices, Showrooms and Exhibition Halls—Special Steel Framing—Power Ventilation—Elevators and Freight Handling Equipment

BESIDES ranking as almost the largest reinforced-concrete structure yet built, the new American Furniture Mart, at Chicago, a 16-story combined office, show room and exhibition building, presents numerous special features in design and equipment, including mechanical ventilation for the entire structure and heavy steel framing for a suspended floor. In plan, the building, shown in Fig. 1, is 218 ft. wide, with sides 467 and 365 ft. long and a 242-ft. front; it has a volume of about 20,000,000 cu.ft. and a floor area of 1,500,000 sq.ft., which latter will be increased to approximately 1,800,000 sq.ft. by a future 83-ft. extension. Few buildings approach this structure in combined height and area, and without its extension it ranks second only to the great army base warehouse at Boston (*Engineering News-Record*, Sept. 9, 1918, p.522) which with eight stories and a size of 126 x 1,638 ft. has a floor area of 1,651,100 sq.ft.

The purpose of the furniture mart is to provide a center for the furniture industry. It contains offices and show rooms for manufacturers and dealers, meeting rooms for conventions, exhibition halls on the first and second floors, and elaborate club quarters on the top floor. In this industry the custom is for manufacturers in certain districts to arrange semi-annual shows or exhibitions which merchants and dealers attend to see the new designs and to place their orders, since the goods are too bulky for the distribution of samples, while the merchants would not undertake to visit the various factories. It may be noted that in 1923 the furniture sales in Chicago amounted to nearly $74,000,000.

Design Conditions—The principal conditions govern the design were much the same as for an office building, a main consideration being the provision of ample floor space with little permanent subdivision by walls and a minimum of obstruction by columns, so that the subdivision may be varied by the construction or removal of partitions to meet the space requirements of tenants. The only permanent divisions of the typical floor, Fig. 2, are an elevator lobby, an 11½-ft. corridor, stairways and shafts, toilet rooms and two transverse fire walls. The corridor is marked by a column spacing different from that of the general floor areas. This typical layout applies from the third to the fifteenth stories, inclusive.

Special requirements included exhibition halls and club rooms, also facilities for receiving and shipping truck loads of furniture. With bulky but light goods of this class no such heavy floor construction was required as in an ordinary warehouse, but on the other hand capacious elevators had to be provided. Separate entrances keep the ordinary business service of the building free from interference by convention and exhibition crowds.

Architectural Treatment—While the general architectural design is limited by the shape and utility purposes of the building, a general Gothic style has been adopted. The great expanse of exterior wall surface is relieved of flatness by being broken into vertical lines of projection, indicating central and corner towers. A bright appearance is effected by the use of a light buff face-brick, trimmed with gray terra cotta, while below the second floor the facing is entirely of gray mottled terra cotta. The roof line is broken by carrying out the tower effect, and at the center of the building is a service tower rising 70 ft. above the roof.

FIG. 1—THE AMERICAN FURNITURE MART, CHICAGO

General Layout—From Fig. 2 it will be seen that the typical floor arrangement consists of a central elevator lobby opening onto a long corridor, with rentable space along each side to be subdivided as required. Toilet rooms and stairways are grouped near the elevators, with additional stairways at the ends of the corridor. For economy of space and cost an approximate column spacing of 20x20 ft. was found to be the most suitable. All longitudinal spans are 20 ft., except that for the entrance and elevator lobby at the middle there is a 25-ft. span flanked on either side by one of 18½ ft. Transverse spans are 20 ft. 1 in., except for a middle span of 14½ ft. at the main corridor and two wall spans of 21 ft. 7 in. which were used to fill out the width of the site.

The first floor is 4½ ft. above the sidewalk. The height from sidewalk is 213.17 ft. or 283.42 ft. to top of tower, which contains the 50,000-gal steel tank for sprinkler service and two horizontal 3,000-gal cylindrical tanks for house service. Upon the roof is a large pent house for the ventilating fans and elevator machinery.

Two main office entrances open from opposite sides into an elevator lobby 25x26 ft.; at the east end, the public entrance to exhibitions opens into a "baronial hall," 57x100 ft., (see Fig. 2) which has a vaulted ceiling at the third floor level. An area of about 67,000 sq.ft. on the first floor is available for exhibitions and is provided with numerous special entrances and exits. The second floor will be devoted probably to exhibitions of carpets, china and other furnishings. Above this the

load per pile was figured at about 22½ tons. [illegible]oncrete footings are 10x10 ft. to 20x32 ft. in plan, abo[illegible] 6 to 10 ft. in total depth, with 16 to 104 piles to a footing. Typical footings are 12.5 ft. square and 8.3[illegible] ft. deep, with 25 piles.

Concrete Frame and Floors—Since the building is to contain bulky but light goods the dead-load of floors was more important than the live-load. For the uniform 100-lb. live-load a beam and joist type of floor

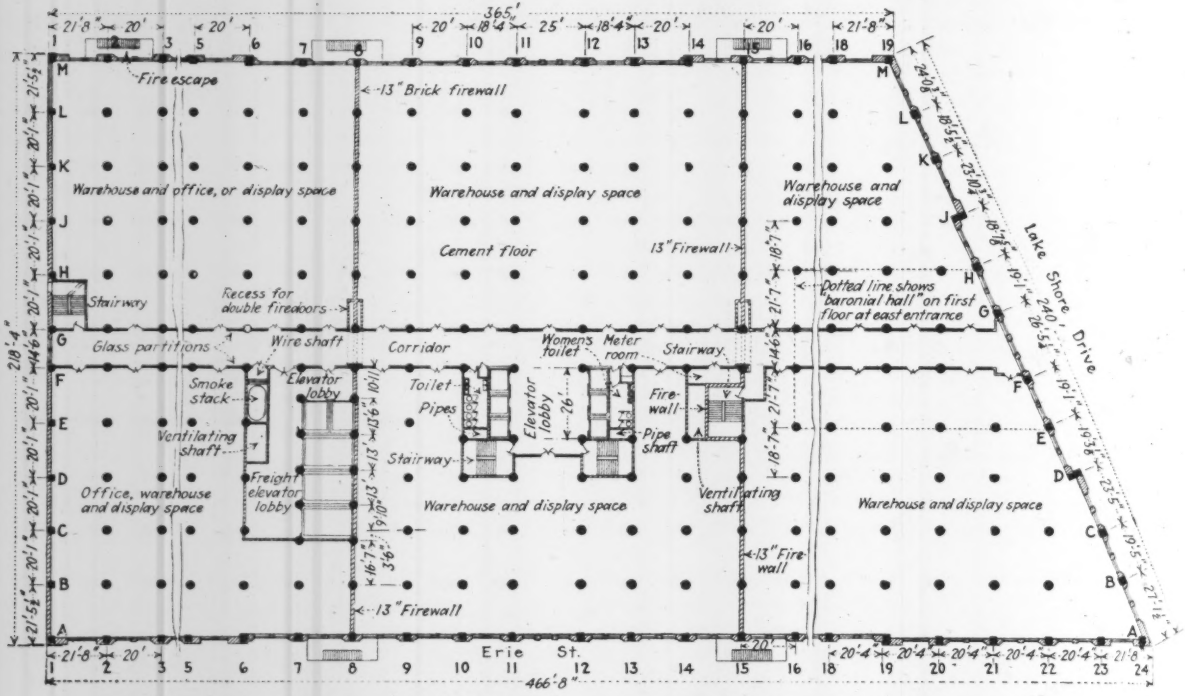


FIG. 2—TYPICAL FLOOR PLAN OF FURNITURE MART BUILDING
Floor area subdivided by tile partitions to provide office, show room and warehouse space as required by tenants. Girders run transversely between columns. Joists run lengthwise of building.

floors are of the typical arrangement shown in Fig. 2, but about 40 per cent of the top floor is devoted to quarters for the Furniture Club, including a large dining room, cafeteria and kitchen. The story heights, from floor to floor, are 18 and 15 ft. for the first and second stories and 12 ft. for all upper stories; between the roof and the ceiling of the 16th story is a space 6 ft. 8 in. high to provide for water, heating and sprinkler mains.

A basement 11 ft. high contains the truck driveway and platform, storage space, power plant, switchboard room and electric substation or transformer room. The boiler room floor is 6 ft. below the basement. The truck platform fronts on a 20-ft. driveway, Fig. 3, which extends entirely across the west end of the building and is reached from each street by a concrete incline of 18 per cent grade. For convenience in maneuvering trucks, the side of the platform is of sawtooth plan, providing six docks 15 ft. wide at an angle of 45 deg., against which twelve trucks can be placed at the same time. Steel roller curtain doors close the driveway when it is not in use.

Foundations—Timber pile foundations were adopted as the site is on a deep bed of gravel affording ample bearing capacity and having a ground-water elevation 1 ft. below datum, or Chicago River level. The average

construction was found to be most economical, especially in view of the absence of concentrated loads. The beams run transversely and the joists longitudinally, but some of the triangular end bays have longitudinal beams. Typical beams are 13x27 in., but the sections range from 20 to 30 in. in depth and 12 to 16 in. in width.

Interior columns are circular and those in the public spaces have ornamental capitals. Typical columns reduce from 36-in. diameter at base to 18-in. in the top floors. Columns on the trucking platform are protected by jackets of No. 12 steel plate secured by countersunk screws to four vertical bars anchored to the concrete. The maximum and typical column loads at the footings are 2,054,000 lb. and 1,113,000 lb.

Typical floor construction, Fig. 4, consists of a 2½-in. slab with 6-in. joists 26½ in. c. to c., the total depth including slab being 10½ in., or 15 in. for the 25-ft. spans. Upon the slab is a ¾-in. cement finish floor. In the first and second floors the slab is 3 in. thick and the total joist depth is 13 in. Wall joists are integral with the spandrel beams. Double joists are provided under the corridor walls on account of the extra load due to partitions. Ceilings of plaster and expanded metal are placed under the joists. For fireproofing, the concrete is 2 in. outside the steel in columns, 2 in. below the bars

in beams and 1½ in. in joists. Piping is laid in the spaces between the joists, but electric conduits and sprinkler pipes are embedded in the floor slab.

Roof construction is similar to that of the floors, except that no ceiling is placed under the joists. Over the office space the roof has two rows of sawtooth skylights 20 ft. wide and 10 ft. high, one facing north and the other south. The glazed side, sloped 30 deg., has hinged steel sash with wire glass; the other side, with a 60 deg. slope, has 10-in. channel rafters carrying concrete tiles 10x1½ ft. A specially heavy floor was required in the tower to support the 50,000-gal. steel tank. Here 12-in. beams, 42 in. deep exclusive of a 6-in. slab, are spaced 36 in. c. to c. and are framed between 16-in. wall girders 10 ft. deep.

Steel Framing and Suspended Floor—The introduction of steel framing was required at three points: (1) over the basement to eliminate a row of columns in the driveway, to carry a suspended floor and to carry the columns above; (2) at the "baronial hall" on the first floor, which is spanned by 34-ft. girders at the third floor level; (3) in the club dining room on the top floor, where 40-ft. girders carry the roof, enabling a row of columns to be omitted. In this third case, the steel girders are supported by the concrete columns.

Since the headroom at the driveway was not sufficient to allow placing deep girders under the first floor, it was necessary to place these girders under the second floor (in the lofty 18-ft. first story) and to suspend the first floor from them by hangers, as shown by Fig. 3. For this suspended deck, about 135x40 ft., steel columns 40 ft. high are placed on concrete and steel grillage footings below the basement floor. The tops of these columns extend 7 ft. 8 in. above the second floor in order to ensure a rigid connection between the concrete and steel columns, and to transmit the load from the former into the latter, while avoiding any direct load from the columns above into the girder connections. These steel columns are of H-section and of very heavy construction, since they carry the loads of intermediate columns in fourteen stories above. The maximum load on the footing is 2,192,000 lb.

Framed against the faces of each pair of columns and resting on brackets are two 60-in. plate girders of 40-ft. span, with their top chords beneath the second floor; 24-in. I-beams are framed between the ends of the girders and a central line of 20-in. I-beam struts is riveted between their top chords at the center line. These I-beams are all placed just below the second floor. On the inner face of each girder web are brackets for the heads of two 2½-in. rods 14½ ft. long, so that there are four of these rods in the 22¾-in. center space of each box or double girder. At the lower ends, the four rods carry a plate 14x14-in., which is embedded in a concrete girder 30x16-in. under the first floor. The hanger rods are encased in concrete, representing columns 20x20 in. A joist and slab floor is built between the concrete girders, and a line of transverse concrete beams is framed between the steel columns at the first floor level. The load on each double girder is from 1,070,000 to 1,140,000 lb.

For the entrance hall, 34-ft. girders are carried by columns about 40 ft. high, which at 11 ft. above the first floor are connected by a line of 15-in. I-beams supporting the front of a balcony or mezzanine floor on each side of the open space.

Miscellaneous Details—Floors of 1½-in. terrazzo tile are used in the offices and corridors, but a concrete surface is preferred for the exhibition rooms and the trucking platform. Marble in 3-in. slabs is used for flooring the baronial hall. Interior partitions are built of clay tile. Stairs are of steel and concrete, but with marble treads in the first story.

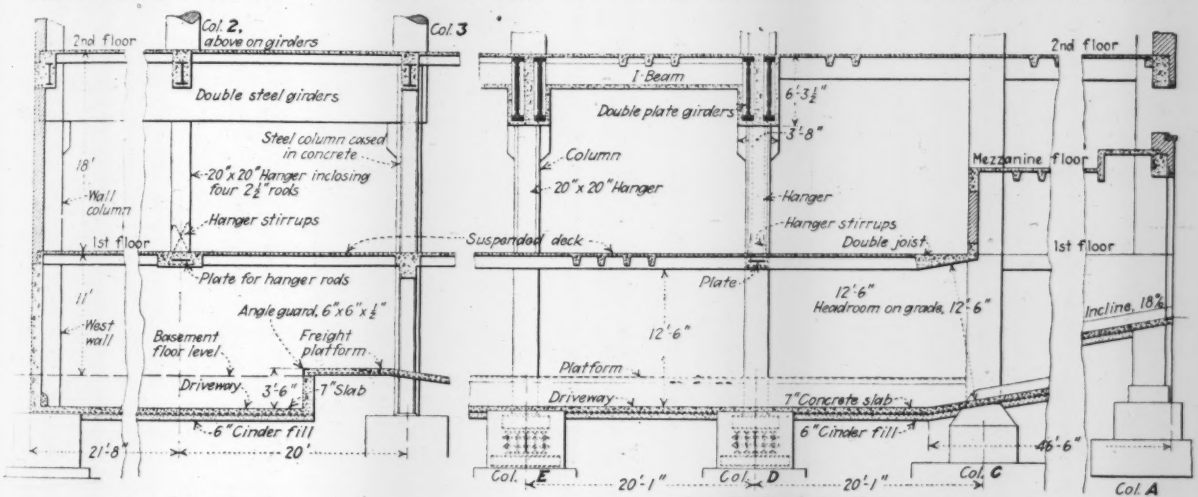


FIG. 3—SUSPENDED FLOOR ELIMINATES COLUMNS IN DRIVEWAY

Steel sash is used for all windows and is fitted with plain glass as there is practically no exterior fire hazard, but wire glass is used at the fire-escape windows. Interior doors and fixtures are of wood, and the corridor walls are mainly of glass extending from floor to ceiling, to give a good show-room effect. Interior lighting is provided by 200-watt lamps arranged with one and two lamps in alternate rows of ceiling panels.

Fire Protection—Owing to the large open spaces and the inflammable character of the contents, a sprinkler system is used throughout, with sprinkler heads spaced 10 ft. apart and served by the large tank in the tower. The sprinkler equipment is on the "wet" system, except that over the shipping platform the "dry" system is used on account of exposure and possible freezing. In all floors the building is divided into three sections by transverse 13-in. brick fire walls, each section having a

stairway. In line with these fire walls are double sliding fire doors to close the corridors; the doors are normally held by fusible links in tile recesses built against the fire walls.

As it was undesirable to subdivide the exhibition space on the north side of the first floor, these fire walls are omitted, but in their place there are double steel roller curtains fitted between the columns and held up by fusible links. The corridors on this floor are similarly equipped on account of the 18-ft. height and the difficulty of providing for sliding doors. Pipes and coils of hose are provided on each floor and three exterior fire escape stairways are provided on each long side of the building.

Ventilating Systems—Mechanical ventilation for a building of this size and class is an unusual feature, and is provided for by two main systems; one for all the floors above the first floor and the other for the exhibition hall on the first floor. For the former, exhaust fans in the pent house above the roof draw the air from the various spaces on each floor through grills opening into the main halls which serve as ducts to the large air shafts near the elevators (see Fig. 2). This system will change the interior air once an hour.

For the exhibition hall, there are separate units located in wall panels beneath the windows, each unit comprising a small intake fan, dust collector and air washer. Exhaust fans are located on the mezzanine floor. This system is designed to change the volume of air six times an hour. For the kitchen ventilation, there is a separate exhaust fan in the pent house, serving ducts and hoods over the cooking ranges. There is also a separate ventilating system for the club rooms.

Mechanical Equiment—For office service there are

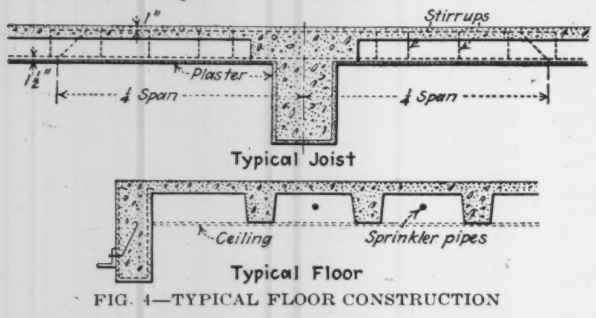


FIG. 4—TYPICAL FLOOR CONSTRUCTION

six 3,000-lb. passenger elevators 6x7 ft. arranged on opposite sides of the lobby and having a speed of 600 ft. per minute. In a separate lobby, shut off from the corridor by swinging doors, are three 4-ton freight elevators about 10x18 ft., and two combination 4,000-lb. elevators, all operating at 400 ft. per minute. The 4,000-lb. elevators may be used for passengers when exhibition or convention crowds are to be handled; it will be noted that they are made convenient of access by having their doors face the corridor, while those of the freight elevators face the lobby. All elevators are operated by electricity and are in charge of attendants. The freight elevators have vertically sliding doors.

For the steam heating service, on the vacuum system, there are three water-tube boilers of 420 hp., with space for a fourth. Coal storage for 1,230 tons, or 30 days' service is provided. The coal is shoveled by hand onto portable belt conveyors which deliver it to the boot of an elevating conveyor feeding overhead bins from which the coal is spouted to the mechanical stokers.

Under the basement floor is a concrete flue 9 ft. high and 10 ft. wide, lined with 3 in. of asbestos felt coated with refractory cement. This flue leads to the steel smokestack, resting on the basement floor. The stack is of oval section, 7x13½ ft., placed in a separate brick

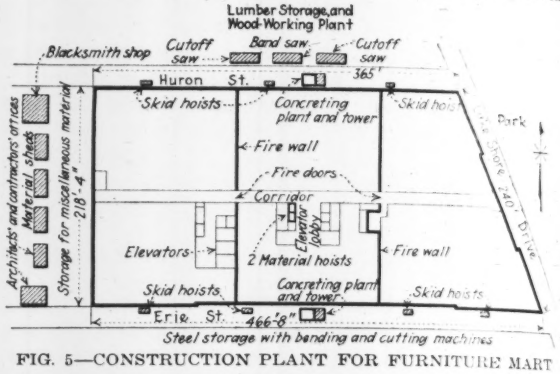


FIG. 5—CONSTRUCTION PLANT FOR FURNITURE MART

shaft, to which it is anchored at intervals. This shaft is insulated from the adjacent wire shaft by a double partition of 4-in. tile with 4-in. air space. The stack is built up in 30-ft. lengths and lined with 2-in. fire brick to a height of 95 ft., or to the 7th floor; its top is 274 ft. above the basement floor or about 40 ft. above the pent house roof.

Electric pumps furnish the house supply of water and drain the basement. Electric current at 1,200 volts is delivered to a transformer room, and thence to the switchboard for distribution to the several power and light circuits.

Furniture to be handled between the shipping dock and the various rooms is stacked on portable platforms about 4x16 ft., having 9-in. legs. Electric elevating trucks lift the platforms and carry them to and from the wagons and elevators.

Construction Work—The layout of the construction plant was simplified by adjacent vacant blocks which were utilized for storage and working space as shown in Fig. 5. For the concrete footings several small portable mixers were found convenient. But for the building, two large concreting plants were installed, and as there was little traffic in that vicinity it was found permissible to place these in the two side streets.

Each concreting plant consisted of a 1-yd. concrete mixer with 1¼-yd. elevating bucket in a 240-ft. steel tower fitted with hopper and distributing chutes. Over the mixers were bins for sand and gravel, served by an elevating bucket conveyor from a pit covered by a grating through which motor trucks dumped their loads. Cement was stored in the space under the bins, behind the charging floor, thus avoiding the rehandling at a separate storage shed. Ordinarily this space was open, but it was closed with canvas at night and in bad weather. Sand and gravel were fed from batch measuring hoppers into a charging hopper, the cement being added to the latter. A steam hoist operated the bucket, but the mixer conveyors and sawmill were operated by electric motors. The two plants could deliver 450 cu.yd. of concrete on each side daily, or sufficient to erect one story per week.

Form lumber and reinforcing bars were raised by self-dumping skid or slide elevators, having inclined platforms sloping towards the two guides against the building, so that as the platform rose above the guides

the load slid off to the floor of the building. Four of these elevators were placed on the longer side and three on the narrower side. Materials for interior work were handled by two platform hoists erected in one of the elevator shafts. A band saw and cutoff saw were also installed on the working floor for convenience in dressing the formwork.

Steel forms were used for the circular columns and metal domes as forms for the floor joists. The latter were corrugated steel troughs, which were left in place. A bottom of light perforated steel was attached to the domes, so that on removal of the falsework the entire ceiling was ready for plastering. In order to speed up the work, the sprinkler pipes, which were attached to inserts in the concrete, were placed between the joists after the removal of the forms. For this purpose the bottoms of the steel domes were omitted where pipes were to be placed, and means were provided for fastening perforated metal across the openings.

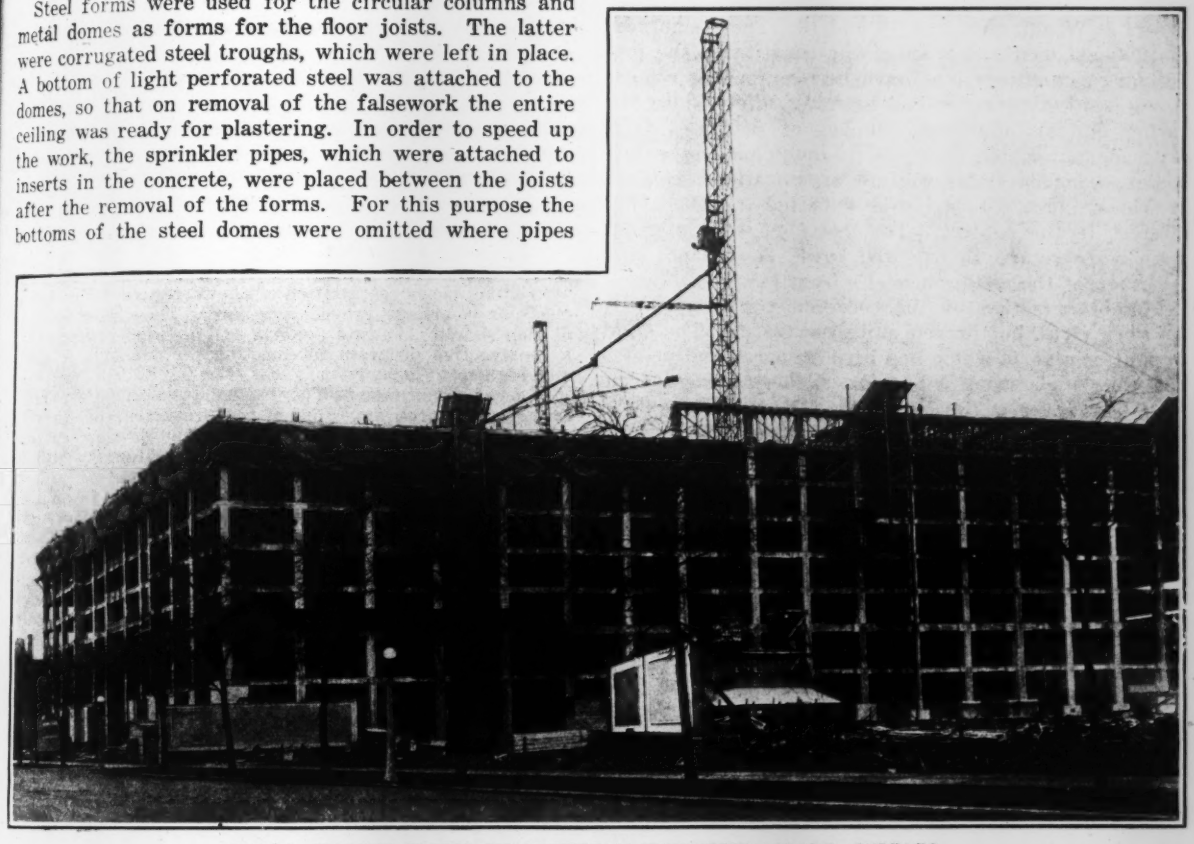


FIG. 6—WINTER WORK ON AMERICAN FURNITURE MART, CHICAGO
Concreting plant and tower on each side. Note skid elevators with inclines at top for automatically unloading lumber and reinforcing steel onto the working floor.

Cold weather did not halt the construction, although the temperature was below 22 deg. F. for a good part of the winter. By enclosing the upper or working story in canvas and by generous use of salamanders a sufficient temperature was maintained to insure thorough setting and hardening of the concrete. On the lower enclosed floors, coke-burning hot-air heaters with forced draft were installed (six to a floor) to maintain a suitable temperature for the comfort of the workmen and to hasten the drying of the plaster. These heaters, of which thirty were used, proved very efficient driers, as the blowers forced hot air circulation to the most distant corners.

For a building of such size and with so many subcontractors it was necessary to insure co-ordination of the several items of work. For this purpose the subcontractors and foremen met each working day with the architect, architect's superintendent and the superintendent of the general contractor, in order to smooth out difficulties and outline the day's work. The main force consisted of 500 to 1,000 men on the day shift. A second shift, which at times was nearly as large as the former, cleaned up the work at night, placed formwork where necessary to prevent delaying the main crew, hoisted material into place and did such other work as could be done most economically after the regular day's work. On a typical day there were 1,074 men at work, including 225 carpenters, 212 bricklayers, tile setters and masons' helpers, 111 plasterers, 85 floor finishers and 208 laborers; the remainder included practically every trade in the building industry.

The work was carried out under the Landis Award conditions. Foundations were built during the summer of 1923. Concreting for the frame and floors went on throughout the winter and the finishing work progressed rapidly the building being opened July 7, 1924.

Designers and Builders—This great building was designed by Henry Raeder, architect, Chicago, with George C. Nimmons & Co. and N. M. Dunning as associate architects. James B. Lund prepared drawings and specifications for the heating and ventilation plant; Lieberman & Hein, civil engineers, prepared drawings for bending and locating all reinforcing steel. The Wells Brothers Construction Co. had the general contract and did all the concreting work; the special steel framing was fabricated by the Morava Construction Co. and erected by the Overland Construction Co. This building, owned by the American Furniture Mart Building Corporation, represents a total cost of about $10,000,000, of which $6,000,000 was for the structure itself, and about $500,000 for the mechanical equipment. The unit cost was 30c. per cubic foot and $4 per square foot of floor area.

Highway Safety Conference Adopts Basic Principles

Recommends Legislative and Regulatory Action and Sets Down Bases of Engineering Design—Plans Methods of Interesting Communities in Highway and Street Safety

NEARLY a thousand persons responded to the invitation of Secretary of Commerce Hoover to attend the National Conference on Street and Highway Safety at Washington Dec. 15 and 16. These embraced the 200-odd men and women who constituted the preliminary committees that have been preparing reports on the subject of street and highway safety since last spring and an additional number of delegates from railroads, automobile associations, municipalities, safety bodies, women's clubs, welfare organizations, etc., all of whom might reasonably be expected to have a live interest in the subject. The meetings were presided over by Secretary Hoover and by F. A. Delano, vice-chairman of the conference.

The organization of the conference was purposely not very rigid, but proved quite successful. The eight committee reports which had been prepared and printed and circulated among a number of those present some time before the conference were discussed in general on the first day. In the evening of that day a steering committee composed of the chairmen of the subcommittees and eight delegates, one each from the professional and industrial groups present, worked the better part of the night on a generalized report which was submitted to the conference on the second day. That report was gone over sentence by sentence, revised and approved. Its main features are given in the succeeding columns.

This final report is a co-ordination and compacting of the committee reports, rather than a new document. Only a few items became fighting points on the floor. The most important of these was the subject of requiring motorists to come to a full stop before going over railroad grade crossings. C. L. Bardo, of the New York Central Lines, chairman of the safety committee of the American Railway Association, proposed an amendment to read as follows: "That the principle of the vehicle stop law at highway crossings at grade is hereby endorsed." This precipitated a long and violent debate, participated in mostly by the representatives of the railroad, who were in force. The arguments of the railroad men were based entirely on a common acceptance as a fact that forcing an automobile to stop before coming to a grade crossing would automatically abolish or certainly materially reduce grade-crossing accidents. No attempt was made to prove this and no attempt was made to disprove it. It was merely a statement of the railroad men. Assuming that statement to be true they argued for the necessity of the law as a protection of life and limb. In opposition the only arguments presented were that this would be a hardship to the busy highways and that the law in some states was not enforced.

Finally, however, Public Service Commissioner Singleton, of Indiana, offered as a motion the following: "We suggest that properly constituted state commissions be empowered to designate dangerous grade crossings at which motorists shall be required to stop." Mr. Bardo agreed to accept this as an extension of his resolution, but on the earnest plea of George Graham, of the Chandler Motor Co., who said that he and the automobile interests would unswervingly oppose the general resolution, Mr. Bardo withdrew his major resolution and the Singleton amendment was adopted as the major resolution.

The main recommendations of the Conference are:

Legislative Principles

There is, in the opinion of the conference, a tendency to include far too much detail in legislation. This not only divides responsibility but also hinders progress toward uniformity. Laws should be so drafted as to include only those features which must be authorized by legislation, leaving the great mass of detailed regulations to be prescribed by the responsible officials whose orders should, within the limits fixed by statute, have the effect of law.

There should be a minimum of restrictive laws and regulations, for the history of transportation shows that restrictive measures written without regard to economic needs have always proved a failure. The system of regulation should take into account and go hand in hand with a constructive program for meeting the demands of street and highway traffic.

Federal Government—The federal government's relation to the safety program is one of encouragement, of assembly and distribution of information, and the development and use of best practices, believing that uniformity will be secured by voluntary action of the various states.

State Government—The state, as the sovereign political unit to which cities and other political subdivisions are subordinate, should enact constructive legislation; including enabling acts to empower cities and other local units to provide for a proper development of their territory; legislation dealing with unorganized areas; and laws creating a state department or bureau to administer the laws applying to motor vehicles, including the issuing and revocation of licenses for both cars and drivers and also the enforcement of regulations on the highway. This may be either a separate department or a division of some existing state department. The motor vehicle department or bureau should have an adequate staff qualified by training and experience not only to handle licenses but to examine drivers, regulate traffic on the highways, investigate accidents and enforce regulations regarding design, construction, inspection and maintenance of motor vehicles.

Regulatory legislation should be for adoption by states and not by cities. The state enforcement division must have sufficiently broad powers to formulate the regulatory provisions necessary to the detailed control of traffic, leaving, however, to municipal authorities the formulation and enforcement of ordinances covering local conditions, such as the establishment of parking areas.

Municipal Government—There should be an adequately manned traffic division in the police department with traffic safety a major function of such bureau. In cities the common practice of enforcement by the police department is recognized, and the police should enforce the state law within the city limits.

Traffic Planning—In all states and municipalities there should be specific provision for adequate and timely planning of traffic facilities and traffic-control measures. These activities should be closely co-ordinated nationally, between adjoining states, between states and their political subdivisions, and between the several agencies charged with the provision of facilities and control of their use.

In metropolitan areas faced with highly complicated traffic movement, it is desirable that there be established a special traffic planning commission.

Grade Crossings—Elimination of grade crossings, either by relocation of highways or rail lines or by grade separation, constitutes the only perfect solution of the grade crossing problem. It should be carried on under a proper program, first eliminating the most dangerous crossings on thoroughfares carrying heavy traffic. This is made difficult by the enormous costs involved, and, if attempted on a wholesale scale, would impose an excessive financial burden resting in the last analysis upon the public. It is, therefore, necessary that the program, having due regard

to the relative costs and advantages of grade-crossing elimination and other methods of protection, be given the most thorough joint consideration by proper authorities. In laying out new highways the question of so locating them as to avoid railway grade crossings to the greatest possible extent should be carefully considered.

Relocation of highways offers many possibilities not yet fully developed which should be worked out by the state authorities, in co-operation with the railways. Authority to order grade separations of proper protection at grade crossings should be vested in the state commission having jurisdiction over the railways, which should also determine and enforce a proper division of the costs between the railroads and the public. The state highway department should have the authority to plan the improvements and to initiate the proceedings for all highways under its jurisdiction. Time is an essential element and a prompt decision should be provided for in the law.

Properly designed state commissions should be empowered to designate dangerous grade crossings at which motorists must stop.

The elimination and protection of grade crossings are of such importance and involve to such an extent the public safety as to require that priority be given to them, in the allocation of capital funds by the railroads, and of public moneys for highway building over expenditures for other safety measures designed to protect the public.

Traffic Courts—Special traffic courts, both city and rural, should be established for the prompt and effective handling of traffic violations.

It is to the public interest that there be state supervision of local procedure in traffic violation punishment, to the extent necessary to secure uniformity of administration and to prevent the abuse of judicial authority.

Licensing of Drivers—No unlicensed person should be permitted to operate a motor vehicle. A reasonable length of time after the passage of the law requiring operators to be licensed should be granted operators already qualified in which to secure licenses without examination. The department or division administering the motor-vehicle law should have full authority to refuse an operator's license to any person and to suspend or revoke a license already issued for any reason deemed sufficient.

Before granting an operator's license, the department or division should determine the applicant's ability to operate a motor vehicle safely by ascertaining his physical and mental fitness and his knowledge of the laws and by requiring an actual demonstration of his ability to operate a motor vehicle. It is recommended that all states designate the minimum age limit, but that no person under sixteen years of age, and no person who cannot read English, should be permitted to operate, drive or direct a motor vehicle.

Penalties—Reckless driving and any other flagrant disregard of the rights of others by any user of the streets or highways should be vigorously and unceasingly prosecuted. There should be legislation providing adequate penalties for infractions of traffic rules, including mandatory revocation of licenses for a specified length of time for cumulative evidence of carelessness or irresponsibility, for operating a motor vehicle while under the influence of intoxicating liquor or drugs, or for other serious offenses against the motor-vehicle law, and severe penalties for driving during the period of suspension or revocation; there should be a sufficient number of organized traffic officers to detect and prosecute such infractions; and there should be co-operation between states for the enforcement of the laws in each state.

The law with respect to motor vehicles should provide that when any motor vehicle is operated with gross negligence or recklessness, in violation of the provisions of the general motor-vehicle law, resulting in serious injury to persons or property, where such violation has been established by due process of law, the registration of the car should be suspended or revoked and its number plates be removed or other means of prohibiting use of the vehicle instituted for a period depending on the seriousness of the offense.

Speed—Regulation of speed vehicles should be directed primarily at reckless driving and should be uniform throughout the country as far as practicable. It should be unlawful to operate a vehicle at a speed greater than is reasonable and proper, having regard for the traffic and the use of the highway, or so as to endanger the life, limb, or property of any person.

In order to promote uniformity the speed limits should be subject to general control by state law, which should prohibit any municipality from establishing a speed limit lower than 15 miles per hour, provided that municipalities and other political subdivisions of the state should be empowered to fix speed-limit zones according to local conditions, but should be required to mark the boundaries of such zones plainly.

In rural areas, instead of an absolute speed limit, it should be provided that when any vehicle exceeds 35 miles per hour that speed shall be prima facie unreasonable, and it should be incumbent upon the operator to prove affirmatively the reasonableness of such greater speed.

Certification of Titles—All of the states should adopt the principle of certification and registration of automobile titles as one of the most important and effective means for reducing thefts, and, by virtue of this result, owing to the casual relation between the theft and accident hazards, also a measure for improving the present public accident situation. This legislation should be uniform and should contain adequate provision for enforcement with proper penalties for violation. Closer co-operation between the various agencies interested in the passage of these laws would be helpful in securing their enactment.

Reporting and Investigation of Accidents—Where they do not now exist, statutes should be passed in every state which would make it the specific business of some state agency, preferably that clothed with authority for issuing or revoking licenses, to receive traffic accident reports and to investigate accidents, whether occurring within or beyond the corporate limits of municipalities.

It should be made obligatory by law for those concerned to report traffic accidents involving serious personal injury or property damage, and an adequate penalty for failure to report should be provided. Such reports to be tabulated and distributed at regular intervals by a state agency to the courts and to the officials responsible for the enforcement of the traffic regulations.

Safety Education in Schools—Education in safety and accident prevention should be incorporated in the curricula of elementary schools, both public and private, parochial schools, night schools, vocational schools, citizenship schools, and schools for non-English speaking adults.

Provision of Playgrounds—Adequate playgrounds throughout the community should be provided.

Provision of Traffic Facilities—The systematic provision of funds is essential to permit carrying on a well-ordered program for the improvement and maintenance of traffic facilities.

Administrative and Regulatory Principles

The legislative authority should grant power to make and enforce regulations and take other action indicated in the following paragraphs. These are not intended to be a complete or exhaustive enumeration of the regulations which should be prescribed, but cover the more important recommendations of the several committees.

Uniformity—Uniformity of traffic regulations is essential. This varies from exact uniformity in the case of definitions of terms, rules of the road, signs, signals and highway markings, and rules for passing railroad grade crossings, to essential uniformity in such matters as reports of accidents, parking regulation, motor-vehicle design, equipment, inspection and maintenance.

Statistics—Statistics regarding street and highway accidents are so vital to any comprehensive understanding and treatment of the safety problem that their collection, publication and analysis in every state and community are essential. Their value depends largely upon prompt and frequent publication.

Accident Reports—In the investigation of accidents sufficiently detailed information should be gathered to indicate clearly whether the accidents occurred because of: (a) Recklessness, carelessness or incapacity of persons; (b) fault of mechanism of the vehicle; (c) physical conditions of the locality where the accident occurred.

Spot Maps—Accident spot maps should be maintained, to be used primarily to detect those points at which accidents occur most frequently, and as a basis for plans to eliminate the conditions which cause accidents.

Traffic Surveys—Special regulations for the use of par-

ticular streets, including the placing of automatic signs and signals, the designation of arterial streets and highways, and restrictions of class of traffic, direction of traffic, parking privileges and the hours and periods of such restrictions, should be based upon competent traffic counts and analyses and established in accordance with some general plan of traffic movement founded upon the design of the street system in each city.

Segregation of Traffic—In congested centers and where large volumes of vehicle movement take place between centers considerably removed, it is suggested that an effort be made to segregate street cars, motor trucks and passenger automobiles on separate thoroughfares, and that attention be given to the desirability of restricting unnecessary use of residence streets through motor truck traffic.

City Planning and Zoning

Street and highway hazards are due chiefly to vehicular traffic. These hazards can be greatly reduced by a proper arrangement of streets and highways. Consequently each community must necessarily study and carefully consider its own special problems with particular emphasis upon:

(a) The problems presented by streets and highways crossing each other at grade or crossing railroad or rapid transit lines at grade, with the two purposes of reducing the number of crossings by a better arrangement of transit lines and thoroughfares and by separating grades so far as practicable where crossings remain necessary. Elimination of grade crossings is most needed along major traffic arteries or boulevards.

(b) The problem of classifying traffic and of providing suitable and adequate facilities for each class. This involves the proper location of the various kinds of development, industrial, commercial, residential, through a proper planning of traffic and other public facilities provided in the various areas, supplemented by zoning regulation of private property.

(c) The location of its traffic-originating centers and the possible development of its outlying areas with the two purposes of straightening main traffic arteries and of so spacing them that there will lie between them areas sufficient in size to support neighborhood stores, schools and recreation facilities.

(d) The possibilities offered by its topography and its present development to create by-pass highways and belt highways which will permit through traffic, especially trucks, to avoid congested districts or even any built-up portions of the city or town.

(e) The control of sub-divisions to avoid in the future the types of streets which tend to congest traffic and cause accidents.

Stopping and Day Storage Space for Automobiles—Each community should reach a decision, based upon present local conditions and probable future development, as to how it will provide for the stopping and parking or day storage of automobiles, and should apply that decision in its city plan.

Design and Equipment of Streets—While the arrangement of streets and parking spaces is the first essential in securing an even and safe flow of traffic, this must be supplemented for each kind of street by determining the most effective width, corner radius, sight clearance, etc., and the needed equipment, such as safety zones or isles of safety, lighting devices, traffic signals, pavement marking. These will differ with the character of the street and the width of its roadway.

Importance of Sub-Centers and Satellites—It is necessary for each region or group of communities to plan more carefully the development of industrial and business subcenters and satellite communities with a view both to encouraging appropriate decentralization and to preventing these new centers from in turn becoming areas of traffic congestion and danger.

Relation Between Street Facilities and Development of Private Property Zoning—Each community should, in determining the character, width and arrangement of its streets, at the same time determine, through zoning, the character, use and bulk of abutting buildings.

Each community or group of communities in planning the main arterial highway system should take account of the effect of zoning regulations in regulating and stabilizing traffic flow.

Playgrounds and Schools—Each community should study the opportunities offered by its territory to provide playgrounds and recreation spaces adequate in size and number so that it will not be necessary to use the roadway for play purposes, and, like the schools, so located that children will not have to cross busy traffic streets in going to and from them.

Subdividers should be encouraged to dedicate adequate recreation space for public.

Inter-relation of Traffic Facilities—Each community should, in planning its traffic system, bear in mind that the automobile and the motor bus supplement rather than conflict with rapid transit rail lines.

Comprehensive Traffic and Thoroughfare Plan Necessary—In order that a community may deal effectively with its problems of street and highway safety it must co-ordinate all its efforts in a comprehensive traffic and thoroughfare plan, showing a complete system of traffic ways, parking or automobile storage areas and needed street improvements both within the city or town limits and within the area of probable building development outside such limits. The traffic and thoroughfare plan should be developed in consonance with a plan for the transportation and transit lines and stations and with the zoning regulations. The adoption of these plans should be followed by a definite long-term improvement and financial program.

Street and Highway Construction

Roadway Width—The roadway of every improved rural highway should be wide enough for at least two lines of traffic. Every pavement in a city street should be wide enough for at least three lanes of traffic without street cars or four lanes with street cars. Those for streets of heavy traffic should be wider. Street and highway pavement widths should be in multiples of widths of traffic lanes; i.e., 9 ft. minimum for motor vehicles and 10 ft. for street cars.

Right-of-Way—Right-of-way for parking space, for clear view at curves and intersections and for future roadway widening should be provided before the cost of the land becomes prohibitive.

Parkways and sidewalks should be so placed as to facilitate future widening with proper provision for safety zones.

Parking Spaces—To make it feasible to prohibit parking or stopping on the traveled roadway, improved rural highways should be provided, either continuously or at intervals not exceeding 300 ft., with reasonably hard and level parking place entirely outside of the traveled way. It is generally not practicable to construct city streets and pavements of sufficient width to provide permanently for unrestricted parking.

Grades—Safety as well as economy requires that grades in excess of 6 per cent be avoided where feasible in laying out or improving thoroughfares of primary importance, whether in country, village or city.

Curves—Highways of primary importance should not have curves of less than 300-ft. radius. Heavy grades and sharp curves should not be combined.

Cross-Section—The cross-section of the pavement or roadway should be as flat as drainage conditions will permit. Curves should be widened and banked and provided with transition curves to effect an easy transition between straight sections of the roadway and the curves.

Guard Railings—Guard railings of substantial type should be erected on the shoulders of embankments.

Clear View—A clear view of approaching vehicles for at least 300 feet should be provided at all points on highways of primary importance. This may necessitate controlling private advertising signs whether upon the public highways or upon private property near the highways, removing trees, shrubs and sloping banks on or off the right-of-way at curves and intersections, and cutting down sharp hill crests.

Street Intersections—At street intersections the grades of each street should be maintained if possible, particularly those of main arteries of traffic. The radius of curvature of curbs should ordinarily be not less than 15 feet, and 20 feet in special cases.

Bridges—Every bridge on an improved highway or street should be at least 22 feet wide, to enable two lines of traffic to pass without difficulty. Existing one-way bridges should be widened or rebuilt. Suitable provisions should be made for the safety of pedestrians, either by sidewalks

or by frequent safety zones built outward so as not to narrow the roadway.

Detours—Detours around highways, streets or bridges under construction or reconstruction should be carefully selected and maintained in safe condition, and clearly marked.

Maintenance and Snow Removal—Safety requires that pavements and roadway shoulders be maintained in good condition. This will include prompt removal of snow from all streets and highways of heavy traffic.

Marking Speed Zones—Local speed limits and other special regulations should be conspicuously announced by standard signs at appropriate places on the highways; these signs shall indicate the beginning and end of speed zones.

Signs and Signals—Cautionary or stop signs and signals at danger points, direction and distance signs at important junctions and intersections, and signs and signals to indicate special traffic rules and regulations are all necessary for the safe operation of vehicles on the streets and highways and should be provided.

For signs and signals, both luminous and non-luminous, the following color indications are recommended, and these colors should not be used for any other purpose: Red for "Stop"; green for "Proceed"; yellow for "Caution," as at curves; some special cautionary indication at crossroads; white letters or symbols to be used on the red or green background, black on the yellow. Distance and direction signs should be black and white and use of imitation traffic signs for advertising purposes should be prohibited.

Besides highway intersections, for which a special color is recommended, sharp curves, steep descending grades and narrow bridges or places in the roadway are danger points, and should be conspicuously marked with yellow cautionary signs. Red stop-signs should be used at the entrances to through-traffic highways.

Railroad Crossing Protection—Railroad crossings remaining at grade should be safeguarded in every reasonable way. Standard warning signs and pavement markings should be used to mark the approach to all public railroad crossings. Where the volume of traffic requires it additional protection should be afforded by the use of flagmen, gates, or approved electric or mechanical devices.

Sharp curves, abrupt changes of grade, roughness in the pavement, or other conditions at or near the tracks which tend to divert the attention of the motorist should be avoided.

The spotting of cars near unprotected crossings by railroads should not be permitted.

Street and Highway Surface Markings—Rural highways should be marked with a white center line on curves, at and near hill crests, at irregular intersections, and at any other points where safety requires that motorists keep strictly to the right. No parking even off the traveled roadway should be permitted opposite these white lines. White center lines should not be used on straight level sections of highway or street except at highway, street or railroad crossings. Black center lines on straight sections of highways are desirable.

Pedestrian lanes should be marked on the pavement at busy intersections.

Objects near the roadway, such as curbs, poles, fences and rock surfaces, should be painted white. Obstructions, such as columns and curbs, at the center of underpasses, should be striped diagonally white and black.

Lighting—City streets should be sufficiently illuminated so that bright headlights will be unnecessary and so that traffic signs will be clearly visible. Flood lighting of traffic officers is recommended. Lights should be provided on state highways wherever the state finds that it is financially practicable.

The Motor Vehicle

Brakes—Pending the adoption by constituted authorities of a code for standard braking ability, all motor vehicles, except possibly motorcycles and heavy trucks, should be capable by means of the service brake alone of stopping in a distance of not more than 50 feet from a speed of 20 miles per hour on a dry, smooth, hard-surfaced road free from any loose material. The emergency brakes should be capable of the same performance as service brakes, but as an absolutely minimum requirement they should be capable of holding the vehicle on any grade which it can ascend.

Steering Gear—Lost motion or play in steering gears should be limited to about 15 degrees. The toe-in of front wheels should never exceed five-eighths of an inch.

Lights—Present lighting regulations should be more rigidly enforced as a necessary beginning in arriving at any improved night-driving condition on the highways.

The study of proper road illumination, combined with the minimizing of undesirable glare should be given immediate further consideration with a view to determining whether it may not be possible to improve the regulations now in force.

Clear red should be used for tail lights and the rear aspect of parking lights, and its use should be prohibited for any other exterior light so located as possibly to be mistaken for a tail light or a parking light.

Clear yellow should be used for "stop-lights" and a maximum permissible intensity of such "stop-lights" be established.

The use of colored lights on vehicles tending in any way to confuse the meaning of the customary safety-lights should be prohibited.

The location of spot-lights should be limited to the right of the vertical center-line of the vehicle and the beam of the spot-light should never be directed to the left of the vertical center-line.

Driver Vision—Design of bodies and cabs should be carried out with due regard to the necessity of reducing to the minimum the shut-off area of driver vision.

The use of all posters or other obstructions to vision on the front windows or on the windshield should be avoided.

Audible Signals—All motor vehicles should be equipped with adequate audible signals.

Motor Vehicle Width—The overall width of body chassis and load of any motor vehicle should be limited to 96 inches.

Inspection and Maintenance—Loading beyond the rated capacity of any vehicle should be prohibited. In the interest not only of safety but of economy of operation, adequate and periodic inspection, adjustment and repair of motor vehicles is absolutely essential.

Public service commissions and other public bodies having control of common carriers operating motor vehicles should establish reports and methods of supervision to insure adequate inspection and up-keep.

Conduct of Drivers and Pedestrians

Pedestrians and Motorists—Pedestrians and motorists should bear a considerate attitude each to the other. Along rural highways, wherever there are suitable sidewalks or paths pedestrians should use them. Where there are none, they can generally walk most safely on the lefthand side facing the traffic, but should not force motor traffic out of line or otherwise impede it. In cities pedestrians should be instructed, urged and required to keep within the boundaries of designated safety zones and crossing places and, when there is congestion, to cross only with the traffic.

Rules of the Road—In city streets, except one-way streets, and on rural highways whenever the traffic is heavy, the current of traffic should be on the right-hand side of the roadway. Heavy and slow-moving vehicles should keep to the right where possible, and their operators should, by mirrors or otherwise, keep a good lookout to the rear so as not to obstruct traffic.

Vehicles before entering or crossing a properly designated "through-traffic" street or highway should be required to come to a full stop. At all other intersections any approaching vehicle should be required to grant the right-of-way to any vehicle approaching from its right at such speed as to reach the intersection at approximately the same time.

Passing—Except in wide city streets carrying two or more well-defined lines of traffic in the same direction, a vehicle should pass another moving in the same direction only on the left-hand side of the overtaken vehicle, and only after giving due warning of approach. Overtaking moving vehicles on sharp curves, approaching hill crests, at intersections or at railroad crossings should be prohibited. An overtaken car should not increase its speed while being overtaken, and the operator of an overtaking car should exercise care not to crowd from the highway the car being overtaken. Street cars stopped to discharge or receive passengers should not be overtaken except where a safety zone or loading platform is provided.

Parking and Stopping—Standing cars should not be permitted to endanger or seriously impede moving traffic, or prevent reasonable access to the sidewalk for loading or unloading of vehicles. This will prohibit the parking or stopping of cars on any part of the traveled portion of a rural highway and also involves the prohibition or vigorous restriction of parking at congested points in cities.

Hand Signals—Safety requires that operators of motor vehicles indicate by hand signals their intent to do anything which may affect the movements of others in the vicinity. Uniformity and simplicity in such signals are both highly important. A single cautionary signal, made by extending the arm well outside the vehicle, as a warning that the operator is about to turn, slow down, stop or back, is recommended as preferable to a code which attempts to show more exactly what the operator intends to do. Vehicles the design of which does not permit the driver to make proper hand-driving signals should be equipped with some simple form of mechanical signal.

Railroad Grade Crossings—Unless full-stop is required by law vehicles should not be permitted to exceed a speed of 15 miles per hour when approaching within 100 feet of any railroad crossing. There should be a penalty enforced against a motorist who disobeys a clearly visible and positive signal to stop at a grade crossing.

Tires—The use of badly worn tires, especially on the front wheels of a motor vehicle, should be avoided as a possible source of danger.

In addition to the specific recommendations set forth above the committee presented a section on suggestions for co-operative work, which gives recommendations as to what associations of officials, unofficial organizations, automobile manufacturers, insurance companies, automobile clubs, schools and colleges, and the general public can do to bring about greater safety. The recommendations for the associations are mainly directed toward community educational work. The suggestions to the automobile manufacturers include recommendations as to the detail design of vehicles, and to the insurance companies to organize in better fashion the keeping of records so that statistics of accidents will be more informing. The major suggestions for co-operative work divide the cities of the country into groups according to size and make specific recommendations as to the methods in which safety promotion work should be carried on in cities.

The Conference also adopted as a program for future activity the continuance of a committee composed of the same membership as the steering committee which prepared the final report at the conference, and the calling of a second conference by the Secretary of Commerce a year from now.

The conference finally states that most prominent among the special phases is the problem of securing uniformity of legislation, regulation, statistics and practices, and suggests that constructive work in the development of uniformity should be immediately undertaken and pushed as rapidly as possible through the operation of voluntary committees.

8,620 Miles Federal-Aid Roads Record in Year

During the fiscal year ending June 30, 1924, 8,620 miles of federal-aid roads were completed, according to the annual report of the Bureau of Public Roads. The total completed since 1916 is 35,157 miles. Work in progress at the end of the fiscal year totaled 5,350 miles. Gravel roads comprised 3,353.8 miles of this year's total completed; grades and drained, 1,604.8 miles; sand-clay, 888.2; water-bound macadam, 106.7; bituminous macadam, 566.6; bituminous concrete, 252.1; concrete 1,667.9; Brick 169.4. Bridges more than 20 ft. in span completed during the year aggregated 10.8 miles.

Roman Surveying Instrument Unearthed in Pompeii

CONSIDERABLE interest was aroused recently when a "groma" or crossbar for rough surveying, was discovered in Pompeii on the floor of a workshop on Abundance St. that collapsed under the weight of the lapilli during the eruption of Mt. Vesuvius in the year 79 A.D., says a recent issue of *Engineering & Mining Journal-Press* in an article written by Don Gelasio Caetani, Italian ambassador to the United States. The article narrates the discovery as follows:

Not many years ago excavations at Pompeii were being carried out in the ordinary way: to free the ruins, the cinders and lapilli were expeditiously shoveled into wheelbarrows and dumped out without being closely examined,

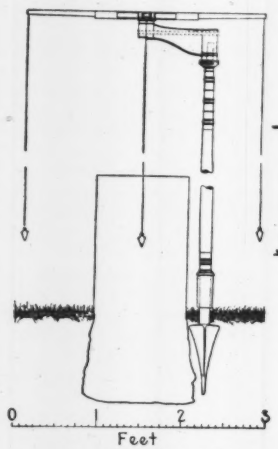


FIG. 2

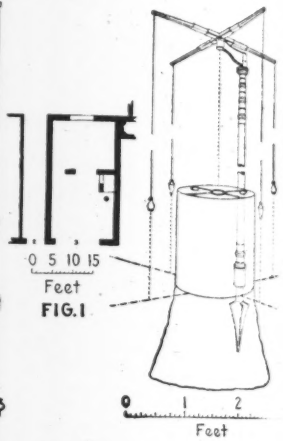


FIG. 1

FIG. 3

THE GROMA AND THE SPOT WHERE IT WAS FOUND

Fig. 1—Floor plan of workshop of Verus at Pompeii. Fig. 2—Sketch of the instrument drawn from Prof. Matteo della Corte's monograph. Fig. 3—Another view of the "groma" on different scale.

and only the large and well-preserved objects of marble or bronze were recovered and placed in the museum. The technique has now completely changed: the dirt is slowly removed layer by layer and carefully sifted so that not even the smallest relic of the past may escape severe scrutiny. When an object, as, for instance, a door, has faded into nothing because made of perishable material, whenever possible a plaster cast is taken of the mold it has left impressed in the consolidated volcanic ash. Then, with infinite patience and accuracy every object is brought back into the position it occupied before the catastrophe, reversing the very movement the object had followed eighteen centuries ago when it collapsed under the weight of the eruptive material. Bricks and stones are piled back into position, fragments of artistic stucco work are recomposed like a Chinese puzzle and fastened into their original position against a reinforced-concrete ceiling, tiles that had fallen on the top of the crumbled building are returned to cover the new rafters of the roof.

A short time ago, while examining the floor of the workshop that had belonged to the mechanic and coppersmith Verus, . . there were found a number of little bronze and iron relics that at first puzzled the director of the work, Prof. Matteo della Corte. After a long and careful study, he succeeded in understanding the true nature of the original object, which turned out to be a "groma" or a crossbar, of the Roman surveyor. The instrument reconstructed in its original form is shown in the accompanying drawings which are taken from a monograph written by Prof. della Corte and published in the Transactions of the Accademia dei Lincei.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Plant Layout for Measuring Bulk Cement and Aggregates by Weight

By C. D. Hale

Structural Bureau, Portland Cement Association, Chicago, Ill.

ANY construction method or plant design which promises improvement in the quality of concrete or increase in the net profits of a job is worthy of engineers' and contractors' attention. A forward step in plant design was made when the concreting plant was planned to furnish concrete for a dam and hydro-electric development on the Fox River at Dayton, Ill.

One of the most interesting features of this plant is that all cement, sand and pebbles are measured by weight. A steel hopper having ample capacity for a 1-yd. batch of materials is mounted under the aggregate bins on the frame of a dial scale. The 30-in. dial of the scale is about 6 ft. back of the hopper in plain view of the operator. The aggregate bins dump directly into the hopper through metal gates and the cement is fed into it by a screw conveyor leading from the bottom of the cement storage bin about 30 ft. away. One man easily measures all materials and feeds the 1-yd. mixer; at the same time very accurate proportions are insured. One operator could feed two mixers of the same size running at capacity.

In operation, the gate from the stone bin is opened allowing pebbles to flow into the hopper until the pointer on the scale approaches the mark for stone posted on the dial. As the pointer approaches this mark the gate is gradually closed and the flow is stopped just as the pointer reaches the mark for stone. When the required sand has been weighed out on top of the stone, the motor driving the screw conveyor is started by a controller mounted at the side of the hopper. When the required cement has been weighed the motor is stopped, and a gate at the bottom of the hopper is opened allowing the contents to discharge into the mixer below.

EQUIPMENT FOR WEIGHING CONCRETE MATERIALS

Gate from stone bin at right, with discharge end of screw conveyor below. Gate from sand bin at left. Dial scale in center.

The measurement by weight has several advantages over measurement by volume. One advantage is flexibility. No adjustment of the measuring hopper or equipment is necessary to change the proportions. If three different mixes are to be used on a job, three sets of markers, indicating the different weights of materials required per batch are posted on the dial of the scale. The operator changes proportions merely by using a different set of markers in weighing the materials. If the proportions all have the same ratio between the fine aggregate and the coarse, as 1:1½:3; 1:2:4, 1:2½:5; the change in proportions would be made by varying the weight of cement used in a batch, allowing the weights of sand and stone to remain constant. Complicated proportions such as 1:1.3:3.2 can be measured as easily as more common proportions. A complete list of proportions with weights for each printed on a convenient card would enable the operator to deliver without delay any mix desired.

MIXING PLANT AT FOX RIVER DAM

Weighing equipment for measuring bulk cement and aggregates on floor level just above mixer.

Another advantage of the weighing equipment is its great accuracy. A uniform quality of concrete cannot be maintained unless all materials are accurately measured. It is well established that a small amount of moisture causes a surprising amount of bulking or swelling of loose sand. This sometimes amounts to 25 per cent or more. If a batch of concrete requiring 12 cu.ft. of sand is measured by volume, it is possible that the 12 cu.ft. of loose damp sand would amount to only four-fifths of that amount or 9.6 cu.ft. if it were dry.

The weighing equipment eliminates most of such errors. The weight of a cubic foot of dry sand can easily be found, and the weight for the required

amount set off on the scale. A few tests will give a reliable idea of the average percentage of moisture in the sand. If this amounts to 4 per cent this correction should be added to the weight of sand as marked on the dial, and subtracted from the amount of water used in mixing, to keep the water-cement ratio constant.

The weight of a cubic foot of bulk cement may vary from about 90 lb. to 110 lb. depending on how it is compacted. Obviously the bulk cement can be measured more accurately by weight than by volume.

The cement comes to the job in box cars and is spotted on a siding with the car door opposite a hatchway in the roof of the cement bin. A broad flat chute is fixed in the car door leading to the cement bin. The cement is then scraped out of the car by three men, one operating a small electric hoist which pulls the scraper full of cement up to the car door. Another man handles the scraper in the car and a third cleans up in the car with a scoop. These three men can unload three cars of bulk cement in a ten-hour day when necessary. No difficulty has been experienced with the cement arching over or refusing to discharge freely from the bin into the screw conveyor.

When a plant is properly equipped to handle bulk cement it has several advantages over sacked cement. The first is that it costs 5c. less per barrel because the cement maker is saved the cost of sacking it. In the second place it can be handled at a lower cost per barrel, as it can be unloaded, measured and handled into the mixer by machinery instead of by man power. Then after it is used there are no lost bags, no work of cleaning, baling and shipping empty bags and no freight charges on returned bags to be prepaid.

The sand and pebbles are unloaded with a clamshell by a stiff-leg derrick from the cars onto a stockpile or directly into the bins over the mixer.

This dam and hydro-electric plant is being constructed by James O. Heyworth of Chicago for the North Counties Hydro-Electric Co.

Detailing Templets for Arch Brick With Pantograph

By R. P. Wallis
Lundoff-Bicknell Co., Building Construction, Cleveland

PREPARATION of full-size details covering certain small items frequently met with on building construction, such as arch brick, either ground or molded, is a necessary preliminary to the manufacture of those items. In the case of arch brick used as trim about door or window openings, the outline to be detailed is frequently one bounded by arcs of flat curvature, requiring special drawing instruments for the proper execution. The office of the average contractor is rarely equipped for detailing of this character.

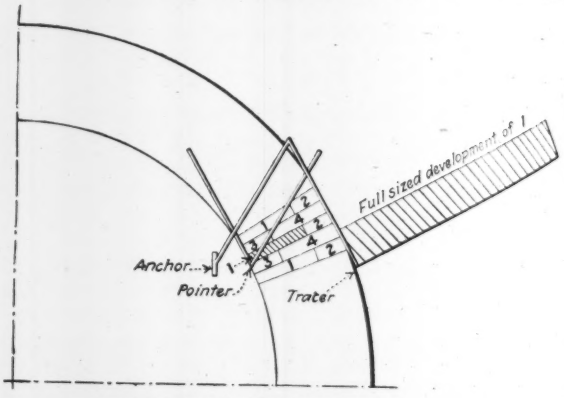
Any one having experienced the physical discomfort incidental to the use of the floor as a drafting board, with miscellaneous brick, table and chair legs, etc., serving as thumb tacks and a bit of string precariously secured to the floor in lieu of a compass, will readily appreciate that the use of such improvised equipment is productive of details of the most uncertain value.

The use of the pantograph has been found to eliminate much of the physical effort involved in the preparation of details of this character and as a consequence has increased the speed and accuracy with which these may be prepared.

From Job and Office

Hints that Cut Cost and Time

When it is desired to prepare templets for arch brick trim of irregular outline, scale drawings (preferably 3 in.-1 ft.) are carefully prepared showing the opening in elevation. The pantograph is then set with the



PANTOGRAPH DETAILING OF ARCH BRICK

proper multiplying factor, a factor of 4 would be correct with a scale of 3 in.-1 ft., 8 for 1½ in.-1 ft., etc., and the full-size outline of each member successively traced.

Each unit of the group should be numbered on the scale elevations and the same numbering scheme preserved with the full-size developments. Only sufficient developments need be made, each on separate sheets, to cover all typical shapes.

Brick Arch Conduit Tunnel Suspended and Underpinned

DURING recent heavy rains in St. Paul, Minn., a brick arch conduit tunnel of the St. Paul Gas & Electric Co. was undermined for a distance of 40 ft. This tunnel carried a large number of power and light cables, also steam mains, which supplied the business district of St. Paul. Any failure on the part of the tunnel would have meant serious loss to the company and its patrons.

The tunnel is located at the foot of a high sand-rock bluff about 17 ft. below the street level which it crosses and is the connecting link between the main plant and a system of tunnels driven through the sand-rock formation underneath the business district of St. Paul. It was built on a bed of fine sand, which at the time of construction many years ago, was considered safe, and lies about 18 ft. over a second tunnel, the lower half of which is driven through sand-rock. At this point the sand-rock is 32 ft. below street level. This street has a grade of about 20 per cent and connects the plant with the top of the bluff.

Storm sewers unequal to the excessive runoff caused by abnormal rains broke, and the water flooded the sand-rock tunnels. As the volume increased through the brick arch section, the sand bed was gradually washed away until finally the whole structure was left hanging with 15 ft. of dirt over it. A settlement in the street was first noticed and immediate investigation disclosed the dangerous condition. It was decided at once to underpin, going down to sand-rock for founda-

From Job and Office

For Contractor and Engineer

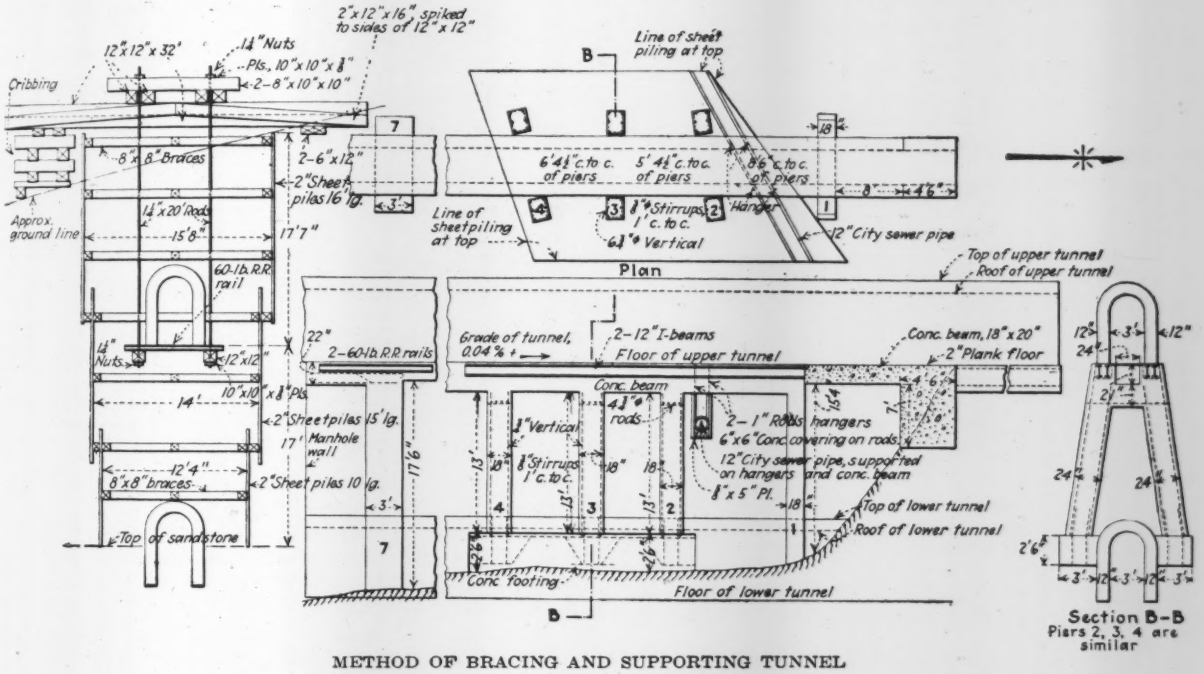
tion. The following method of procedure was at once begun:

Temporary shoring was put in where necessary and excavation started. As this progressed 2-in. sheeting was driven and waling sets dropped in at proper points. When the bottom of the first arch was reached, 72-lb. rails 7 ft. long were placed across at the floor line on 3-ft. centers and an 8x10-in. timber laid underneath the ends of the rails on both sides. Across the top of the excavation and blocked up on a 28-ft. span, double 12x12's on 5-ft. centers were placed. These were carried on this length of span to relieve, as far as possible, pressure on wales and sheeting. Two lines of 12x12's were placed over the double 12x12's and 1⅛-in. rods were run from the lower timbers supporting the rails to the top timbers and drawn up until a set had taken place in the top timbers. The loads carried were 2,000 lb. per foot of cables and steam mains and 2,500 lb. per foot of masonry.

After suspending the arch, excavation proceeded rapidly until sand-rock was reached and the new concrete footings and columns were poured. Two lines of 12-in. I's were set on the columns, wedged up to the under side of the brick masonry and concreted in. A 14-in. sewer line which ran across the excavation and below the first tunnel was supported by hanging a reinforced-concrete cantilever beam on rods from the double I-beams.

As soon as possible, suspension members were removed and the floor of the tunnel poured. After work in the open excavation was completed it was found necessary to underpin an additional 30 ft. of tunnel located between the curb line of the street and the plant. A driveway which carried considerable traffic made it impracticable to work this section as an open trench, so it was decided to sink shafts 3 ft. x 3 ft. from the bottom of the old arch down to sand-rock, concrete these and then pour reinforced-concrete beams under both sides of the arch.

This work was carried out successfully without any interference to operation by Siems, Helmers & Schaffner, Inc., under the direction of N. F. Helmers.



METHOD OF BRACING AND SUPPORTING TUNNEL

After excavating concrete piers were placed under upper tunnel as shown.

Note on the Accuracy of Estimates

By C. A. Rupp

Adjunct Professor of Applied Mathematics, University of Texas, Austin, Texas

DURING the past summer the writer had ample opportunity, in the offices of Lovering-Longbotham & Co. of St. Paul, to observe from the point of view of the mathematician the process of preparing an estimate. The common practice was to multiply the number of units, as taken from a quantity survey, by the unit price, as determined by the contractor's records, and round off the product to even dollars. The point of this paper is that ordinarily this rounding off can be carried much farther, with a consequent great reduction in the labor involved, without sacrificing any real accuracy.

Suppose that the contractor figures on excavating 8,418 cu.yd. at a unit price of $0.50, making by customary reckoning $4,209. But what does this unit price of $0.50 really mean? Surely nothing more than that the true cost per yard lies between $0.495 and $0.505. That is, the unit price may be incorrect by as many as 0.5 cents or, on a percentage basis, the unit price may have a 1 per cent error. This leads to the conclusion that the product, $4,209, must also be in error by perhaps as much as 1 per cent, that is, the actual cost may be as low as $4,167 or as high as $4,251. As long as

the unit price is not known with more than two-figure accuracy we have no mathematical justification for relying on more than the first two figures in our product. It is far easier to round off the cubic yardage to two-figure accuracy, i.e. 8,400 cu.yd., and then multiply by the unit price getting $4,200. The old method gives results which are doubtful beyond the second place, so why bother with the doubtful figures?

In adding up the items, a doubtful figure in any one item will make the whole column in which that figure lies doubtful and throw out completely all columns to the right of that one. This means that if one item, say excavation, is known to be correct to hundreds only, we ought to round off all items to hundreds. This may mean that we disregard entirely numerous small items, such as a couple of areaways. Thus, in scaling off the plans we need not be too particular for we should know that our final figure may not have more significant figures than the corresponding unit price.

The only mathematical way to inject more accuracy into the process is to secure more adequate knowledge of unit prices, so that we may be sure of three figures rather than two. Here we run up against the practical question of how close a similarity may exist between two jobs. It rather seems to the writer that genuine three-figure accuracy in, for instance, excavation, is almost impossible to attain. Remembering that if one important item is uncertain beyond the hundreds, all the remaining items contribute nothing to remove this uncertainty, and accordingly may themselves be rounded off to hundreds without destroying the accuracy of the whole, it appears that much may be gained by a frank recognition of the fact that the present method of computation shows a fictitious accuracy.

The writer has computed some fifteen estimates of buildings ranging in cost from $12,000 to $300,000 by both methods; in no case was the variation greater than 1.2 per cent, and the process he recommends took about one-third the customary time.

Making House Service Connections in Water Main

By W. W. Monk
Foreman Pipelayer, Shanghai Waterworks Co., Ltd., Shanghai, China

Many water and gas engineers, who have experienced difficulty in making house service connections to steel mains, may derive some benefit with the following method of making what may be known as "the expanded metal joint." Suppose a 1-in. connection to a steel main is to be made; the process would be as follows:

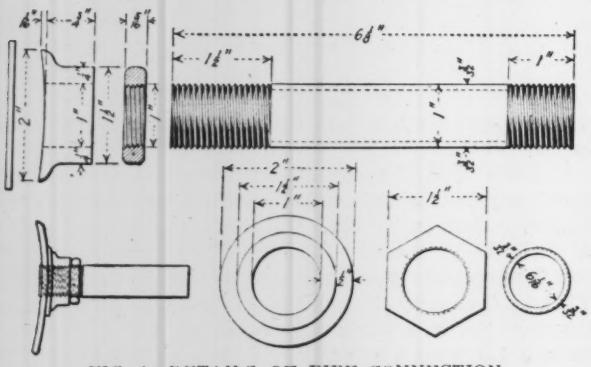


FIG. 1—DETAILS OF PIPE CONNECTION

(1) Drill a hole through the pipe, taking care not to have the hole too large. Tap and thread the hole.

(2) Take a piece of 1-in. boiler tube and cut a thread at both ends; one end should be long enough to project ½ in. above the collar, as shown in Fig. 1; the other end should be made to suit the socket of the proposed connection.

(3) A small collar is made out of an old piece of square steel and turned down in a lathe as shown in Fig. 1. The hole in the center is just large enough to allow the tube to pass through it; the curve on the bottom of the collar must be made to suit exactly the curve on the pipe, making a snug fit all around.

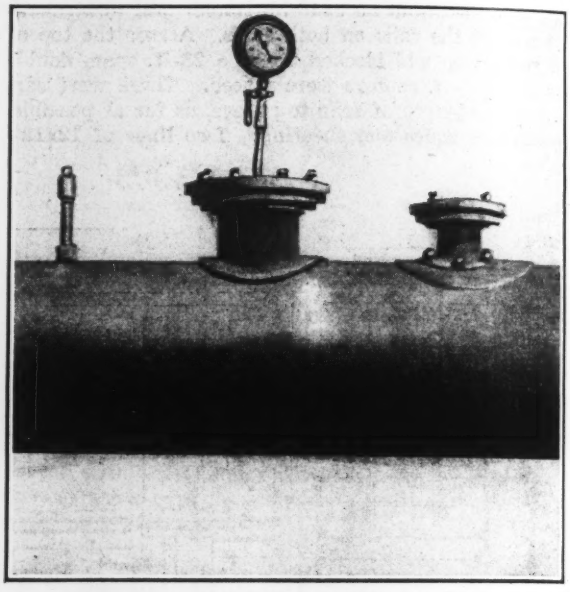


FIG. 2—JOINT UNDER 90-LB. PRESSURE

(4) A small rubber washer is cut to suit the diameter of the base of the collar, leaving ¼-in. clearance all around. A 1-in. back nut is now put on the end of the tube referred to in (2).

Place the 1-in. tube through the collar and rubber washer, then tighten them up together; but the collar must be held steady in its place while the back nut is being screwed up. Fig. 2 shows one of these connections under test at 90 lb. per square inch.

All sizes of connections can be made from ½ in. to 2¾ in. on steel mains of from 6 in. to 30 in. in diameter. The cost is very little compared with other patent joints.

The most important thing is to see that the drill is not too large and that the thread is properly cut. Machine drills should be used as they only give a clean cut. No spun yarn or red lead is necessary. It is necessary for the tap to pass through the hole once only with a taper tap; and the smaller the hole the better the result.

It is advisable that those who wish to try these joints try first on large mains, say 16 in. in diameter.

The reason for using boiler tube is that the thread does not burr over as easily as the galvanized-iron pipe when threading. The 1-in. back nut must be filed down to take off the burrs and made to fit snugly around the top of the strengthening collar.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Highway Traffic Analyses

Sir—Under date of Dec. 11 an article from the report of the Committee on Highway Traffic Analysis is published in *Engineering News-Record*, p. 957, with the title "Object and Methods of Highway Transportation Surveys." This has been noted as being by the writer. This committee of the Advisory Board on Highway Research consists of A. H. Blanchard, Michigan; A. N. Johnson, Maryland; N. M. Dougherty, Tennessee; J. G. McKay, Washington; J. H. Mullen, Minnesota; and the writer as chairman. The particular article referred to was the work of Professor J. G. McKay of the committee and was incorporated in the committee's report. In fact, the entire report is the compilation of reports by the various members of the committee on the assigned subjects, and credit should be given to the committee or to the individual member rather than the chairman.

G. E. HAMLIN,
Chairman, Committee on Highway Traffic Analysis.

Hartford, Conn.,
Dec. 15, 1924.

Torsional Strength of I-Beams

Sir—Valuable comment on the subject of the torsional strength of steel I-sections is contained in the letter of L. B. Tuckerman in *Engineering News-Record* of Nov. 27, p. 882, written in discussion of the tests of C. R. Young and C. A. Hughes reported in Bulletin No. 4 of the School of Engineering Research, University of Toronto.

While agreeing with Mr. Tuckerman as to the distinction between "torsional stiffness" and polar moment of inertia, the present writer does not believe, however, that the use of the term "effective polar moment of inertia" will prove other than convenient to the practical designer. In many cases the latter approaches torsion problems equipped only with the round-shaft theory, and wishes to know in what respect the quantities involved in the common formula should be modified in order to give the correct results when applied to non-circular sections. Obviously, the quantity that needs modification is the polar moment of inertia. If by experimental means a reduced value of this, or say, an "effective polar moment of inertia," J', can be found which when inserted in the common torsion formula,

$$q_e = Te/J'$$

will give for a stated torque T the corresponding maximum shearing stress q_e, and vice versa, the strength problem if the designer is essentially solved. The only illogical feature of this procedure is that the computed stress exists, not at the extreme corner of the section, but at the center of the outer edge of the flange or of the outer edge of the web, depending on which element is the thicker.

In the latter part of the paper in question (beginning p. 140) an effort was made to develop an alternative, but admittedly less simple, method of determining maximum shearing stresses based upon the shearing modulus, the unit torsion angle and the flange or web thickness. Comparing Young and Hughes' formulas (8) and (9) with Mr. Tuckerman's method, it is evident that our "effective polar moment of inertia" is $2\ (d/t)^{0.45}$ times Mr. Tuckerman's J. However, although our expression is a little more complicated than his, it will be seen by comparing column (6) of our Table 5 with the last column of his table, that our results are more consistent.

Dependence on empirical expressions ought not to disturb the designing engineer, accustomed as he is to formulas of this class. As a matter of fact, the torsional stiffness $J = M/\theta G$, the use of which Mr. Tuckerman favors, must be finally fixed empirically. Föppl's approximation is so rough that, as was found by Mr. Tuckerman, the results must be adjusted in the light of experiment to the extent of 57 per cent for the range of beams considered. For design purposes, where the torsion angle θ is unknown, one must in effect depend on some method of forecasting it. The method of Hughes and Young forms, it is believed, a satisfactory means of doing this.

The series of tests under discussion was undertaken rather more as a preliminary study of a small range of beams in torsion than as a comprehensive and highly precise investigation. For this reason the individual irregularities of the specimens were not introduced. In a more extensive study which it is hoped to undertake at no distant date, these and other pertinent matters will be given full consideration.

C. R. YOUNG,
Professor of Structural Engineering,
University of Toronto.

Toronto, Ont.,
Dec. 11.

Land Areas Irrigated but Not Farmed

Sir—In your issue of Nov. 13, p. 788, you print an article on the monograph of R. P. Teale, "Irrigation and Drainage Laws," in the course of which the following statement appears:

> As the total area of irrigation projects exceeds the actually irrigated area by about 17,000,000 acres, there is a large margin for settlement and farm development before additional irrigation works should be necessary.

This sentence clearly conveys the impression that there was in 1920 an area of 17,000,000 acres for which the irrigation works were constructed and on which no cultivation was being carried on. The bulletin from which this article is abstracted shows an equal area under the heading of "Excess of area in irrigation enterprises over area irrigated in 1920," with the source of this data given as the Census Bureau. The difference in these designations is very material. From numerous investigations of irrigation projects throughout the West I have found the area listed under this heading by the Census Bureau to include "projects" in all stages of development from a preliminary survey to fully constructed works. Many of these so-called projects are clearly infeasible from the standpoint of water supply, regardless of costs.

As this information is used to convey the impression that constructed works would care for the increase in farm development of the irrigated area for a term of 35 years, it is requested in justice to the many agencies financing irrigation works that the author state in your columns the area of undeveloped irrigable lands under completed irrigation works in 1920 for which an adequate water supply was available. It is further requested that the authorities for the answer given be cited.

Denver, Colo.,
Nov. 24, 1924.

E. B. DEBLER,
Engineer, U. S. Bureau of Reclamation.

Sir—The paragraph cited by Mr. Debler is not an exact quotation from the bulletin, but does reflect the spirit of the bulletin. In both the bulletin and the Census report along with the figure referred to, are given the area irrigated in 1919—19,191,716 acres—and the area to which existing enterprises were capable of supplying water in 1920—26,020,477 acres.

These figures show the excess of area which the enterprises were capable of irrigating in 1920 over the area irrigated in 1919 to have been 6,828,761 acres. This figure does not exactly supply the information asked in the last paragraph of Mr. Debler's letter, "the area of undeveloped irrigable lands under completed irrigation works in 1920 for which an adequate water supply was available," because undoubtedly some of the land not irrigated for which water was available was in projects in the course of construction. However, it does answer the spirit of his question.

The figures given are taken from the report of the Fourteenth Census. I have at hand only the summary of the census of irrigation published by the Bureau of the Census prior to the publication of the final reports, and, consequently can not give a page reference to the final

volume. Volume VII of the reports of the Fourteenth Census consists of the reports on irrigation and drainage, and these figures will be found in that volume. I noticed the abstract of my bulletin published by you but have not a copy at hand and do not recall just how far you went. The bulletin can leave no doubt in the mind of anyone as to my opinions on the point raised by Mr. Debler. I have nothing to add to what I said there, and see no reason to change the opinion expressed.

R. P. TEALE,
Agricultural Economist, U. S. Department of Agriculture.

Wheatland, Wyo.,
Dec. 12, 1924

Road Corrugation

Sir—I am interested in the comment of Mr. Hogarth of the Department of Highways, Ontario, on your editorial, "Road Corrugations Not Explained." Mr. Hogarth draws the conclusion that "Corrugations would seem to be the initial indication of failure of gravel road."

Mr. Hogarth's observations and conclusions based on conditions in Ontario will not apply to conditions as we find them in New Mexico, western Texas, Arizona and eastern Colorado.

Road corrugations occur in this state where no question of drainage can enter. They occur as frequently in gravel cuts at summits where drainage is well nigh perfect as they do in low ground where ground water level is 1 ft. from the surface as is the case in numerous places in the Rio Grande Valley.

They occur as frequently where the gravel is 8 to 10 in. deep as they do where it is barely 4 in. deep. The writer has observed one or two instances where corrugations are noticeably less than on other and adjacent roads, where gravel is the surfacing material, and it has been possible on these exceptional roads to eliminate corrugations, as they occur, by simple dragging.

On the road where this almost complete absence of corrugation is observed, the grade of material entering into the surface construction is quite different from anything else we have had. The surfacing material is practically 100 per cent minus one-inch and about 40 per cent of it grades down uniformly from this size to material retained on one-quarter mesh. The remaining 60 per cent is material between 20 mesh and ¼ in., most of it running around ⅛ in. It is a quartoze material, the particles of which are coated with what is locally termed lime binder.

It is this minus ¼-in. material which seems to act most effectively to prevent corrugations. The body of the surfacing compacts slowly with or without moisture, but there is formed on the surface a layer of loose material ¼ to ½ in. in depth which protects the lower compacted section from the direct impact of traffic by forming a cushion, as it were, and this cushion seems to hinder the formation of corrugations.

E. B. BAIL,
New Mexico State Highway Department.

Albuquerque, New Mexico,
Dec. 12, 1924.

Tests of Sand Pressure Against Walls

Sir—In *Engineering News-Record*, Nov. 13, 1924, p. 804, J. L. Campbell records the results of his experimental work on the overturning effect of soils on sustaining walls. The test wall was 12x12 in. and a known force at ⅓ the height was required to cause failure by overturning (rotation about the toe). A fill of dry sand was placed between the wall and a fixed oblique plane, a "smoothly planed board on maximum pressure angle." The letter concludes with the sentence: "I think that this statement in connection with the data set forth on the blueprint is all that is necessary to enable engineers to analyze the experiment intelligently."

Before proceeding to the results of a detailed analysis of these experiments, the writer, as a matter of introduction, wishes to state that as a result of a lengthy study of earth pressure experiments as well as some research of his own, he would expect that the pressure of dry sand against a sustaining wall would be closely given by the theory of the wedge of maximum pressure as developed by Poncelet, the resultant pressure deviating from the normal to the wall by an angle whose tangent is the coefficient of friction between the fill and the back of the wall.

For a summary of the formulas covering the two cases studied by Mr. Campbell, the writer refers to his discussion in *Engineering News-Record*, March 22, 1923, p. [illegible].

It will be noticed that Mr. Campbell assumes that the angle between the vertical wall and the "maximum pressure angle" line is the same for the two cases of level and maximum sloped fills. As a matter of fact, in the above mentioned discussion, the writer showed that if the friction of the fill on the wall is disregarded, this angle is ½ (90 deg. — Φ) for the case of level fill and twice that value for the case of fill at the slope of natural repose. If wall friction is taken into account, the former value is somewhat larger, but the latter remains (90 deg. — Φ). This is all from purely theoretical considerations, which, it might here be stated, have been fairly well proven by experiments.

Mr. Campbell used three different materials, loose dry sand (4 tests) of 97.7 lb. per cubic foot, compacted dry sand (4 tests) of 108 lb. per cubic foot and compacted wet sand. The curious phenomenon is recorded that the compacted sands showed a *negative* pressure. This is true of every one of the five tests with compacted sand, called by Mr. Campbell — P_2, P_4, P_5, P_7 and P_8. The experimenter does not record the earth pressures for these cases and so failed to notice this startling result. The force required to overturn the wall with the compacted material in back of it was *greater* (in one case, even more than four times as great) than the force required to overturn the wall without backfill.

The writer will willingly agree that friction acts on the back of the wall, but he cannot see how a dry granular mass possessing practically no tensile strength can hold back a wall, or how the vertical component, which cannot exceed in magnitude the horizontal component times the coefficient of internal friction of the mass, can overcome the overturning effect of the horizontal component. As a most liberal assumption, the coefficient of internal friction cannot be as large as 0.6, *i.e.*, somewhat less than the tangent of the angle of natural repose; the lever arm of the vertical component is 5 in., that of the horizontal component is at least 4 in. The error must lie in the method of testing, which is not fully described; the probability is that the process of compacting the fill clamped the wall to the base of the apparatus.

For a 12 in. wall, 12 in. long, a dry loose sand, level fill, 97.7 lb. per cubic foot and an angle of internal friction of 32 deg., the maximum angle of wall friction is also 32 deg. A greater angle of wall friction would result in a layer of soil clinging to the back of the wall and separation then occurring (or tending to occur) between two surfaces of the filling material the friction between which is denoted by the angle of internal friction. For such a case, the Poncelet wedge theory gives a value of 11.5 lb. for the horizontal component and 7.2 lb. for the vertical component. The effective overturning moment is 11.5x4 — 7.2x5 or 9.6 in.-lb.; the equivalent horizontal force acting 4 in. above the base is then 2.4 lb. This agrees exactly with the value of 2.4 obtained from P_3.

If the wall is backed with smooth wood, the angle of wall friction is about 27 deg., and the corresponding earth pressure has components of 12.4 (horiz.) and 6.3 lb. (vert.); the resulting overturning moment being 18.1 or an equivalent horizontal force of 4.5 lb. as compared to 4.38 obtained from P_1. The value for the angle of wall friction, as well as other empirical data used below, is taken from the writer's report on earth pressure tests in the 1923 *Transactions* of the Am. Soc. C. E.

For the case of fill at the natural slope, the theoretical horizontal component is independent of the wall friction and should be 35.2 lb.; the vertical component depends upon the wall and is 21.1 for the rough wall and 18.0 lb. for the smooth wall. The corresponding overturning moments are 54 and 69 in.-lb. respectively. These values are based on the assumption that the resultant in this case acts at ⅓ the height above the base. The corresponding effective horizontal forces acting at 4 in. above the base are 13.5 and 17.3 lb. as compared with 5.4 and 7.2 lb. from the experiments. The test values are low because the wedge of sand was far too small to permit the "wedge of maximum pressure" to act.

JACOB FELD,
Professional Engineer.

Brooklyn, N. Y.,
Nov. 21, 1924.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Motor Traffic Problems Discussed at Roadeo Dinner

Results of efforts being made to co-ordinate highway traffic facilities in metropolitan areas, where federal, state, county, township, and city authority is involved, where outlined in an address by Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, at the annual motor roadeo dinner held in the Union League Club, New York, Dec. 18, under the auspices of the National Automobile Chamber of Commerce. Citing the specific case of Chicago, Mr. McDonald described conditions in the "No Man's Land" or belt, intervening between rural and urban highways and acting as a bottle-neck to choke traffic. Overlapping and indefinite authority over routes in this belt area is responsible for inadequate linking of the city with the rural districts. Mr. McDonald explained how these conditions in the Chicago metropolitan district are being corrected by joint co-operative effort.

The national program of highway development, Mr. McDonald stated, now involves yearly expenditures of about $1,000,000,000 for construction and maintenance.

A. J. Brosseau, director of the National Automobile Chamber of Commerce and president, Mack Trucks, Inc., offered suggestions on what should constitute the basis of highway finance. The present rate of expenditures for highway developments, $1,000,000,000 yearly, represents, according to Mr. Brosseau, the peak, but this rate of expenditure, he believes, will continue for the next ten or twelve years.

The meeting was presided over by Roy D. Chapin, president of the Hudson Motor Car Co., who in his introductory remarks included among the more important developments of the year the change in motor-car design resulting in smaller vehicles, better braking, and balloon tires. The motor bus, he said, has made great strides and is now in design and construction, a modern vehicle.

Contractors Plan Conference

Contractors from the principal cities have been invited to a conference to be held at Cleveland Jan. 5 under the auspices of the National Association of Building Trades Employers. The purpose of the conference is to enable the contractors of representative cities to get together to discuss mutual problems. The invitation to general contractors was decided upon at a recent meeting of the executive board. Other action of the board included passage of resolutions to resist action on the part of building trades mechanics to shorten the working week to five days.

Winter Construction Articles Ready in Reprint Form

The series of four articles on

Winter Construction

from the point of view of the contractor, written by Charles S. Hill, associate editor, and published in "Engineering News-Record," Oct. 2, 9 16, and 23, 1924 are now available in reprint form. The pamphlet contains 15 pages, with paper cover, and will be mailed on receipt of 10 cents. Address your request to

The Editor

Engineering News-Record,
10th Ave., at 36th St., New York, N. Y.

Big Power Development to Result from Consolidation

One of the first projects to be undertaken following the completion of the negotiations which are now reported to be under way for the acquisition of the San Joaquin Light & Power Corp. by the Great Western Power Co. will be increasing the height of the Big Meadows Dam on Lake Almanor in California by 45 ft. This will increase the storage capacity of the lake to 1,317,000 acre-ft. and will give it a capacity greater than the combined capacity of all other reservoirs in the state of California. The enlargement of Lake Almanor will be followed by the installation of a fourth 22,000-kw. unit in the Caribou plant on the Feather River.

Regional Planning Association for Buffalo District

Representatives of Buffalo, Niagara Falls, Lockport and other communities in Erie and Niagara Counties, N. Y., have organized the Niagara Frontier Planning Association to deal with problems common to six cities and 22 villages. The president is Alexander J. Porter, Niagara Falls, and the secretary is H. A. Chapin, Tonawanda. It is proposed to obtain state legislation creating a committee of 13 members to devise improved highway, transportation, harbor, park and parkway, bridge and other facilities. The movement has been conducted under the auspices of the New York State Commission of Housing and Regional Planning.

Boston & Maine R.R. Proposes Motor Truck Lines

In order to forestall financial losses of such magnitude as to imperil the whole financial structure of its company, resulting from the operation of many branch lines at a loss, the executive committee of the Boston & Maine R.R. has announced a plan for a reorganization of the company which will include the abandonment of 1,000 miles of branch line, substituting for the service now rendered by these lines a motor truck and bus service operated on the public highways. Money to finance the motor service is to be obtained through a readjustment of the present method of financing the railroad system.

Earlier in the year the railroad company organized the Boston & Maine Transportation Co. to study this matter of substituting motor truck and bus operation for the operation of steam trains on a number of its branch lines. This company will serve as the nucleus of the organization to operate the new service if the Interstate Commerce Commission approves of the proposition.

The Boston & Maine is now operating motor buses between Ashburnham and South Ashburnham, Mass., in place of its former service on a spur 2.6 miles long. In the old service a passenger train made four round trips a day, but in the new service the bus makes eight round trips.

Contract for Camden Approach of Delaware River Bridge Let

At a meeting of the Delaware River Bridge Joint Commission on Dec. 19, bridge contract Number 20, for construction of the Camden approach from Third St. to east of Fifth St., was awarded to the O'Neill Co., Philadelphia, upon a bid of $408,161. Bids were opened Dec. 17, as follows:

O'Neill Co.	$408,161.00
Fred'k Snare Corp.	414,377.00
F. J. Boas	414,950.00
Vare Constr. Co.	417,915.00
Triest Contr. Co.	421,700.00
Nelson-Peeley Co.	425,926.15
Fish-Rutherford Co.	430,046.00
Mazzola & Marano	447,237.00
McLean Contr. Co.	449,505.00

The work under contract 20 includes the construction of concrete footings and concrete pile foundations, the construction of concrete masonry with granite facing, the construction of structural metal-work for the approach and the construction of sewers and inlets in streets adjacent to the bridge approach. Both the Philadelphia and Camden approaches have now been placed under contract, with the exception of the final or "plaza" blocks.

War Department to Discuss Construction Policy

Technical and Trade Associations Are Asked To Send Representatives To Washington Jan. 16

Washington Correspondence

Representatives of a number of technical societies and trade associations have been invited by Secretary of War Weeks to meet War Department officials and civilian advisers in Washington Jan. 16 in a conference regarding the construction policy of the Department, both in the event of a war emergency and in times of peace.

The conference is believed to foreshadow a policy of unified control of all matters relating to construction works by the military branches of the War Department. The fact that the invitation does not limit the discussions to an emergency policy but specifically includes a policy of peace-time construction is considered of much importance.

The War Department held a conference Oct. 20 with 29 prominent contractors, engineers, transportation men, labor experts, architects, accountants and attorneys, all of whom had been associated with the Department in its construction work during the World War.

Invitations Sent Out

At this conference, it was recommended that a more general meeting, to include these interests and material supply men and others whose services and advice were felt necessary, be called at a subsequent date. An executive committee with Gen. R. C. Marshall, Jr., general manager of the Associated General Contractors of America as chairman, was named at this conference to take up arrangements for the subsequent meeting with Secretary Weeks.

As a result, Secretary Weeks has just written the presidents of various large associations requesting them to appoint either four or five representatives to meet at the Washington Hotel at 10 a.m., Jan. 16, for the purposes indicated. Those who attended the October conference, or were invited to attend it, are included also.

Among the organizations requested to send representatives to the January conference are:

American Association of Engineers, American Concrete Institute, American Construction Council, American Institute of Accountants, American Institute of Architects, American Institute of Consulting Engineers, American Institute of Electrical Engineers, American Institute of Steel Construction, American Iron and Steel Institute, American Railway Engineering Association, American Society of Civil Engineers, American Society of Heating and Ventilating Engineers, American Society of Landscape Architects, American Society of Mechanical Engineers, American Society of Sanitary Engineers, American Water Works Association, Associated General Contractors of America, Building Trades Department of the American Federation of Labor, Mixer Manufacturers' Bureau affiliated with the Associated General Contractors, National Association of Building Trades Employers, National Association of Manufacturers, National Association of Sand and Gravel Producers, National Board of Fire Underwriters, National Lumber Manufacturers Association, National Retail Lumber Dealers Association, Portland Cement Association, Prepared Roofing Association, Surety Association of America, Western Society of Engineers.

Progress in Florence Lake Tunnel of Big Creek Project

The 2¾-mile middle "leg" of the 13-mile Florence Lake tunnel being driven in California by the Southern California Edison Co. was holed through on Oct. 29. This is the central connection between two tangents, 20,910 and 34,783 ft. long, respectively, on which work is now in progress. A description of tunneling methods on this work was published in *Engineering News-Record*, May 3, 1923, p. 776.

Up to Dec. 1, the best monthly progress was as follows: Camp 60, October, 692 ft.; Camp 61, September, 609 ft.; and Camp 62, July, 650 ft. Two notable weekly records were made; the heading driven from Camp 60 was advanced 174 ft. in one week of October and the east heading at Camp 61 was advanced 171 ft. one week in September.

Thus far the excavation in the main tunnel has all been made through solid gray granite with the exception of a few hundred feet in soft ground and consequently had to be timbered and is now being lined with concrete.

It is expected that the two remaining sections of the tunnel will be holed through about the first of March, 1925, and after the removal of rails, blower pipe, etc., the tunnel will be ready to convey the waters of the south fork of San Joaquin river into Huntington Lake reservoir, whence it will supply the series of plants operated by this company on Big Creek.

Tablet to Prof. A. N. Talbot and Dr. Edward Bartow Unveiled

A tablet to Prof. Arthur N. Talbot and Prof. Edward Bartow in recognition of their pioneer services in sanitary engineering in the development of the septic tank and the activated-sludge process was unveiled recently at Champaign, Ill., by W. C. Field, president of the Illinois Association of Sanitary District Trustees. On the tablet, which is

MEMORIAL TO PROFESSORS TALBOT AND BARTOW

attached to a boulder, as shown in the accompanying view, is the following inscription: "On this site, 1897, the Champaign septic tank was built; designed by Prof. A. N. Talbot. It was among the first of its kind in this country. Dr. Edward Bartow and associates, 1913-1916, carried on the first experiments in this country on the activated-sludge process of sewage treatment."

Railways Plan Work for 1925

Reports received recently as to railway improvement works planned for 1925 include the following:

New York, New Haven & Hartford R.R.—Physical improvements proposed total $2,750,000, as follows: new freight yards and extension of present yards, $550,000; shop facilities, $900,000, with $250,000 in addition for tools and equipment; signaling on 79 miles, $450,000; grade separation, bridges, etc., $600,000. It is intended also to spend $750,000 on electric locomotives and gasoline motor buses.

Reading Lines—Grain elevator and ore-handling plant at Port Richmond, $3,000,000 and $915,000 respectively; freighthouse facilities at Lebanon, Pa., $207,515; passenger station at Tabor, Pa., $28,500; Huntingdon St. connection to Broad St. subway at Philadelphia, $15,000.

Pennsylvania R.R.—Track elevation, Louisville, Ky., $2,500,000; Little Creek freight terminal, Norfolk, Va., $2,000,000; engine terminal, Altoona, Pa., $2,000,000; station improvements, Altoona, $1,750,000; new station, Lancaster, Pa., $1,000,000; Meadows yard near Newark, N. J., $1,000,000; grade separation at Main St., Toledo, Ohio, $680,000.

Great Northern Ry.—Rebuilding ore dock in reinforced-concrete at Allouez, Wis., erecting new steel superstructure for bridge over the west channel of the Mississippi at Minneapolis and building a connection from this bridge to the passenger station. With additional main and yard tracks, filling trestles, installing automatic signals for 343 miles and automatic train control between Minot and Williston, N. D., the approximate cost will be about $2,871,500. In addition, new equipment already authorized will cost about $7,231,500.

Cleveland, Cincinnati, Chicago & St. Louis Ry.—Important items of work proposed include grade separation at Dennison Ave., Columbus, Ohio, $300,000; roundhouse extension at Kankakee, Ill., $230,000; freighthouses at Galion and Bellefontaine, Ohio, $60,000 and $40,000.

Louisville & Nashville R.R. — Improvements authorized during 1924 represent a total of $32,300,000, including $10,000,000 for 95 miles of double tracking and $6,000,000 for rebuilding bridges; the amount expended was $20,700,000 leaving $11,700,000 to carry on the work in 1925. About $793,000 have been authorized for new freight stations and terminals, including a large warehouse at New Orleans, and $393,000 for three passenger stations. In addition, expenditures authorized or under contemplation for rails, double tracking and equipment approximate $8,000,000, making a total of about $20,000,000 outstanding for work in 1925.

Chicago & Western Indiana R.R.—The principal work projected is track elevation from Indiana Ave. east to Colfax Ave. and south from Stony Island Ave. to 110th St., including an overhead crossing of the Illinois Central R.R. and ten subways.

New Jersey Plans Boulevard Approach to Hudson Tunnel

Highway Commission Plans Through Wide Road 12 Miles West of Hudson River

A year ago an advisory board of engineers presented to the New Jersey State Highway Commission a study of the probable traffic west of the west portal of the vehicular tunnel now building under the Hudson River between New York City and Jersey City and recommended the construction of certain highways intended to take care of the enormous motor traffic which that tunnel will develop. The commission last week adopted in principle the recommendations of the advisory board. These recommendations call for a through road from the west portal of the tunnel in Jersey City to connect with the Lincoln Highway west of Elizabeth and also for the widening of certain roads to the north.

The so-called Route No. 1 extension, that is the road from Jersey City to Elizabeth, is the major part of the plan. This roadway is recommended to have a minimum width of 50 ft. in places where parking of automobiles will not be permitted, that is on viaducts and in open cut, and 60 ft. in all other places. It is to have a granite block pavement on a concrete base. The highway is, as noted, a through one with no grade crossings, which involves the construction of open cuts in Jersey City and a viaduct over the Palisades, and either tunnels or bridges crossing the Hackensack and Passaic Rivers. The total estimate for this highway is around $28,000,000 which would be reduced to about $20,000,000 if bridges instead of tunnels were used at the river crossings. The estimate for the northern connecting link, which is to be a 40-ft. roadway, is $1,300,000.

While the commission announces that it expects to let contracts for the beginning of this work at an early date, the allocation of funds has not entirely been decided, but it is understood that the commission considers that there are sources of revenue which will permit them to carry on the work at least at sufficient speed so that some relief of the expected traffic may be afforded when the tunnels are opened in 1926.

A later article will be published in *Engineering News-Record* giving the fuller details of the Commissioner's report.

Pit 3 Tunnel Holed Through

The last section of tunnel being driven for hydro-electric project No. 3 on Pit River in northern California by the Pacific Gas and Electric Co. was holed through on the morning of Dec. 5 when crews met in the section between Rock Creek and the intake. The other section of this tunnel was holed through on Dec. 2.

A description of driving methods in this tunnel which is 20 ft. in diameter and has a total length of 20,981 ft. was published in *Engineering News-Record*, July 31, p. 168. The entire bore is to be lined with concrete and this work is already under way at the lower end where one lining outfit is at work; later four lining outfits will be used.

Control of Gulf Coast Lines by Missouri Pacific Approved

The Interstate Commerce Commission has approved the purchase by the Missouri Pacific R.R. Co. of the capital stock of the New Orleans, Texas and Mexico Ry. Co., the principal component of the Gulf Coast Lines. As the New Orleans, Texas and Mexico recently acquired control of the International-Great Northern R.R. Co., and as the Missouri Pacific, in the reorganization of the Denver and Rio Grande Western R.R., obtained a half interest in that railroad, it will now have a system of about 14,000 miles made up of:

	Miles
Missouri Pacific R.R.	7,362
Gulf Coast Lines	1,173
International-Great Northern R.R.	1,160
Texas and Pacific Ry.	1,953
Total	11,648
Denver & Rio Grande Western (half interest)	2,604
Total	14,252

Plans for the consolidation of these railroads into one system have not been announced and it is understood that none has been made, but that the roads will continue to be operated as at present.

Bridge Contract Awarded on Yosemite Valley R. R.

Contract was awarded on Dec. 2 to the U. S. Steel Products Co. for supplying and erecting five steel bridges and viaducts on the Yosemite Valley R.R. in California, which will total about 3,600 tons of steel. The steelwork will be fabricated in the Gary shops of the American Bridge Co.

Special interest attaches to this job because of the erection problems that will be involved by the high piers, particularly on the longest spans which will be placed on concrete piers about 250 ft. high. This work is part of the relocation of the Yosemite Valley R.R., made necessary by the construction of the Exchequer dam being built for the Merced Irrigation District and which will flood the present right-of-way.

Five bridges or viaducts are involved in the new work, all within a distance of eight miles and involving spans as listed in the following table:

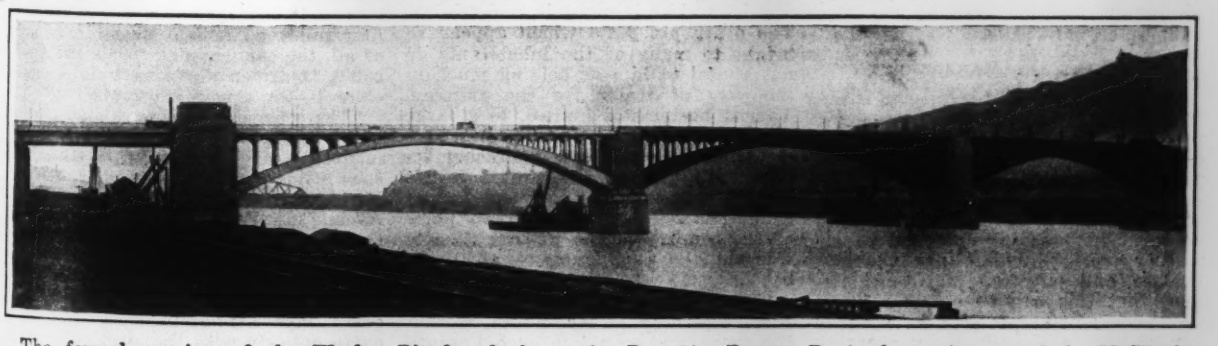
Bridge No.	No. Spans	Length, Feet	Kind of Span
One	Three	60	Deck Girders
Two	Two	60	Deck Girders
	Two	40	Deck Girders
Three	Two	634	Continuous Trusses
	Four	80	Deck Girders
Four	Three	80	Deck Girders
	One	110	Deck Girders
Five	Four	110	Deck Girders

The railroad relocation is to be completed next fall so that the reservoir can be used to impound next winter's runoff.

Illinois Society Plans Meeting

At the annual meeting of the Illinois Society of Engineers, to be held at the Great Northern Hotel, Chicago, on Jan. 14 to 16, the main portion of each of the six sessions is assigned to one of the separate sections: Drainage, sewerage, surveying, water supply, roads and pavements, and mechanical, mining and electrical. For the sewerage section the program includes round-table discussions on: (1) Relative merits of combined and separate sewers, (2) operation of sewage-treatment works. E. E. R. Tratman, Chicago, associate editor of *Engineering News-Record*, is president; secretary, H. E. Babbitt, Urbana, Ill.

Washington Crossing Bridge, Pittsburgh, Completed



The formal opening of the Washington Crossing bridge at 40th St., Pittsburgh, is set for Dec. 29. Benno Janssen was the architect, Charles S. Davis the engineer, and the McClintic-Marshall Co. the steel contractors.

Alaska R.R. Report Made to Interior Secretary

More Expenditures Needed to Reduce Cost of Maintenance—Railroad Methods Lacking

Drastic changes in personnel and large expenditures to reduce the cost of maintenance are the means of improving the Alaska R.R. which Noel W. Smith would use if he were to take over the management of that property for the government.

In July Mr. Smith was borrowed from the Pennsylvania R.R. to go to Alaska to investigate conditions on the government-owned railways and to report on them. (*Engineering News-Record*, July 17, 1924, p. 116.) For this purpose he was appointed special assistant to the Secretary of the Interior and evidently was given wide powers, for he took over the detail operation of the railroad soon after his arrival and directed that heads of departments report to him; an action which was followed by the resignation of the general manager, Lee H. Landis, which became effective Nov. 10, 1924.

Mr. Smith's preliminary report to the Secretary of the Interior makes no such startling accusations of inefficiency or mismanagement as might have been expected from the rumors coming from Alaska. He merely states that his action in regard to changes in personnel would have been more drastic had he gone to Alaska as a permanent employee. Such changes, he states, he has left for the future general manager to make. He is specific, however, in the matter of excess personnel, pointing out, for instance, that Nenana on the Tanana River had, during the past season, in addition to the agent, a port captain and a general agent, both of which positions Mr. Smith considers unnecessary. He also states that the heads of departments have never been required to strenuously prosecute their work, nor to examine into the simplifying of methods, nor to require the return from each individual employee that is prevalent on the railroads outside.

The accounting department is handicapped by having to maintain two separate systems of accounting; namely, the budget system and the acounting prescribed by the Interstate Commerce Commission. All departments are handicapped by a lack of inter-departmental co-operation such as has been built up on most railroads.

Property and Management

As to the physical property itself, Mr. Smith recommends a six-year program of construction for the expenditure of $11,000,000 in improving the property in order to reduce the present excessively high cost of maintenance. About $9,000,000 of this amount is to be spent in widening cuts and banks, raising track, ditching, line changes, bridges, and culverts. Mr. Smith figures that this can be carried out to the best advantage if the work is spread over a period of six years in order to keep the amount of new equipment required to a minimum.

On account of the isolation of the Alaska R.R. Mr. Smith recommends that great care be taken in selecting a new general manager, for, although he does not consider the management a difficult task, yet the man who has to manage it should have a general knowledge of all features of railroading, because he is not in a position to obtain the advice of other experienced railroad men as is the average manager of a small railroad.

Two prospects for an increase in the traffic on the Alaska R.R. alone appeal to Mr. Smith. They are the development of gold mining in the Fairbanks district and an increase in coal mining. The other prospects which appear so bright to many of the inhabitants do not appeal to him as holding much in the way of traffic for the railroad. Tourist business is limited, to a large extent, by the uncertainty of accommodations on the boats operating between Alaska and the United States proper. There is not sufficient freight being handled between the two parts of the country at the present time to warrant the putting on of additional boats.

The greatest need of the Alaska R.R., according to Mr. Smith, is that the properties be put in such physical condition that the maintenance-of-way expenses can be reduced to a minimum.

San Francisco Bay Bridge Contracts Awarded

Contracts were awarded on Dec. 18 for building the concrete piers and erecting the structural steel spans of the $3,000,000 Dumbarton highway bridge across the lower end of San Francisco bay. The contract for piers went to the Healy-Tibbitts Construction Co. of San Francisco, and for the structural steel to the Moore Dry Dock Co. of Oakland. Actual construction is to start immediately according to John L. Harrington, engineer in charge of the project. Previous reference to this bridge appeared in *Engineering News-Record*, Sept. 7, 1922, p. 411.

The new bridge, which will provide a direct and shorter route from the San Joaquin Valley to San Francisco, will be located 33 miles south of that city by highway at Ravenswood Point, which is 1½ miles from the Southern Pacific Dumbarton bridge. The construction of a highway bridge at this site has been under consideration for several years, plans have long been worked out in detail and permission from the War Department and county authorities, the necessary rights-of-way, etc., have all been secured. The calling for bids and awarding of contracts have been awaiting the financial arrangement, and these were recently completed when the necessary funds for the work were entirely subscribed by a group of San Francisco capitalists.

Original design called for a bridge of eight 200-ft. fixed spans and one 310-ft. draw span. Both approaches would be supported on concrete piles, the western approach being 1,768 ft. long and the eastern approach 1,734 feet.

Random Lines

Blah!

(*A Harper's Bazar Circulation Letter*)

"Society Engineers"....a New Expression for a New Avocation

IF CONTEMPLATING the purchase of a manufacturing plant you would not send a milk man, tailor or drug clerk to inspect the property. You would send an engineer. When a publisher actually wants to guarantee the highest quality of circulation he does not employ a school girl or a seamstress. Harper's Bazar uses Society Engineers. That is....society women of the younger set.

* * *

The following is an invitation issued by the San Francisco Engineers Club to its December 20 meeting.

Ye feaste and faste throughout ye yeare,
Of whatsoever merit,
Mean little to ye Engyneere
Who hath noe time to spare it.

But when ye cheer of Xmas Day
Ie burgeoned through ye lande,
Ye Engyneeres bedyme a gay,
Albeit pious, bande.

They'll gather at ye meetynge guild,
Fulle copiously eatynge;
And then, content, with bellye filled,
Exchange theyre Xmas greetyng.

Ye robed choir will chant ye layes,
Ye fiddler whine ye tune,
And what ye gifted speaker sayes
Ie loot in quiet swoone.

So come eache goodlye Engyneere;
Lay by yon slide-rule worne,
And marke with fellowship sincere
Ye daye The Childe was born.

And They Say His Salary is $75,000 Per Year

Arthur Brisbane, Mr. Hearst's famous editor, has discovered the solution of the transit problem. He says:

"Important news to commuters and congested cities comes from Paris. Monsieur Lauer, 84 years old, has invented the aero car. The car, 7 ft. high, 7 ft. wide and 40 ft. long, is suspended below a cable 42 ft. in the air, slung from poles far apart. Each car carries 100 passengers and the speed is fifty miles an hour. Most interesting of all, the car, hanging below the steel cable, is driven along as a flying machine is—by a powerful propeller.

"The scheme, would solve nine-tenths of the traffic problems in cities and for suburban travel in the country. Imagine such a line running along the center of Michigan Avenue in Chicago or Fifth Avenue or Park Avenue, New York. Only a few steel poles, far apart. What an improvement on street cars or buses, crawling on the surface."

"The only improvement I would suggest," says a correspondent, "is to do away entirely with the steel poles and substitute therefor the apparatus well known to all engineers—'skyhooks.'"

Home-Rule City-Like Charter for Westchester County, N. Y.

A tentative draft of what is substantially a city form of charter of the home-rule type has been made public by a subcommittee of the Westchester County Government Commission, acting under authority granted by a constitutional amendment adopted two years ago. The draft is subject to modification and approval by the commission by the existing Westchester County Board of Supervisors and the New York Legislature, and in whatever form it might pass the legislature it would have to be approved by the voters of the county to become effective. William Wallin, ex-mayor of Yonkers, as chairman of the subcommittee.

The proposed charted provides for a board of supervisors of limited powers, a county president, a vice-president who is to be chairman of the board of supervisors, a commissioner of finance and a treasurer. These would be the only elective officers and would replace the present board of 46 members and numerous other elective officers.

The president would be the chief executive officer of the county with powers and duties much like those of a mayor under the mayor-and-council separation-of-powers plan, but some of his powers would be shared with a board of estimate and apportionment and some with a department of contract and supply. The budget would be prepared by the board of estimate for submission to the supervisors.

Among eight proposed executive departments are those of contract and supply, health, public works and buildings, and engineering. The board of contract and supply would be made up of the president, vice-president, finance commissioner, county attorney and county engineer—three elected and two appointed officers.

The board of estimate and apportionment would have power to investigate the advisability of establishing county systems of highways, water supply and sewers and also a county zoning and planning system.

Appointments and Promotions in Engineer Reserve Corps

Announcement of appointments and promotions in the Engineer Officers Reserve Corps is made by the War Department. The list follows:

Colonel—George W. Bunnell, Brookline, Mass.

Major—Joseph E. L. Millender, Dallas, Texas; Roger B. McWhorter, Florence, Ala.

Captain—Eugene L. Brown, Chicago, Ill.; Llewellyn G. Couter, So. Bend, Ind.; Stephen E. McMaster, Altoona, Pa.

First Lieutenant—Joseph A. Diffendaffer, Norman, Okla.; Paschal Grimes, Norman, Okla.; Irving T. Norton, Northampton, Mass.; John H. Pattrick, Kansas City, Mo.; Frederick A. Platte, New York City.

Second Lieutenant—Herbert Butcher, Bayonne, N. J.; Thomas F. Gilligan, Bronx, N. Y.; Louis W. Goodrich, Ft. Madison, Ia.; Bernard McCullough, Mole Hill, W. Va.; Arthur K. Patterson, Altoona, Pa.; James Singer, Los Angeles, Calif.; Gordon M. Smith, El Paso, Texas; William H. Smith, Sound Beach, Conn.; William A. B. Wheeler, Natchez, Miss.

PROMOTIONS

Captain—Wilbur P. Burritt, San Bernardino, Calif.; Ernest D. Clabaugh, Berkeley, Calif.; John P. Kelly, Rochester, N. Y.

Engineering Societies

Calendar

Annual Meetings

NATIONAL DRAINAGE CONGRESS, Chicago, Ill.; Annual Convention, Chicago, Ill., Jan. 5-7, 1925.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Ill., Jan. 5-9, 1925.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 12-14, 1925.

AMERICAN ENGINEERING COUNCIL, Washington; Annual Meeting, Washington, D. C., Jan. 16, 17, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 21-23.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 27-29, 1925.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, Ill., Feb. 3-5, 1925.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 24-27, 1925.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Convention, Chicago, Ill., March 10-12, 1925.

The San Francisco Section, American Society of Civil Engineers, held its annual meeting Dec. 16. The election of officers resulted as follows: President, H. C. Vensano, contracting engineer; vice-president, N. A. Eckart, principal assistant city engineer, San Francisco; secretary-treasurer, F. H. Fowler, consulting engineer. At this meeting it was announced that the board of directors of the section, in view of what they designated as "an attack upon the professional ability and personal integrity of Charles Gilman Hyde" in the recent East Bay water campaign, adopted a resolution expressing confidence in Professor Hyde, in his professional ability and his personal integrity. On report of this action by the board, the meeting unanimously voted its endorsement. The paper of the evening was by C. Derleth, Jr., chief engineer of the American Toll Bridge Co., and dean of engineering at the University of California who gave an illustrated talk on "The Design and Construction of the Carquinez Highway Bridge."

The Dayton, Ohio, Section of the American Society of Civil Engineers at its December meeting elected the following officers: C. D. Putnam, president; F. J. Cellraius, vice-president; J. K. Grannis, vice-president; C. H. Eiffert, secretary and treasurer.

New York State Association of Builders will hold its annual convention Jan. 29 and 30, 1925, at Buffalo; it is planning an educational and business program which will be announced soon.

Personal Notes

JOHN T. WALSH is president and M. J. Roach vice-president of the contracting firm, Roach & Stansell, Inc., newly organized to do levee work on the Mississippi River, the offices of the firm being in the North Memphis Savings Bank Building, Memphis, Tenn. Walker Stansell retires from the firm.

COLONEL HERBERT DEAKYNE, Corps of Engineers, U. S. A., who has for four years been stationed at San Francisco, has received orders appointing him division engineer, northeast division, with headquarters at New York. He will leave for the new post on Jan. 20, going via the Panama Canal by army transport. Colonel Deakyne has been at San Francisco since September, 1920, in charge of the First District, rivers and harbors, and also has had charge of the seacoast fortifications. He has also filled the position of division engineer for the entire Pacific Division. Major John W. N. Schulz, who has been military assistant to Colonel Deakyne, takes over the duties of district engineer at San Francisco

Obituary

WILLIAM L. SACKETT, Illinois state superintendent of waterways, died at Chicago, Dec. 16.

JOHN W. ROSE, for more than forty years superintendent of bridge building for various railroads, died Dec. 11 at St. Josephs Hospital, Willimantic, Conn., from injuries caused by a recent fall. Mr. Rose was 90 years of age and early in life shipped aboard a whaler with his father. Later he gave up the sea life, and prepared himself by study for bridge engineering. He was engaged on bridge building for the Boston & Providence Railroad Corp., which eventually became the New York, New Haven & Hartford R.R.

WALTER F. BALLINGER, architect and engineer, president of The Ballinger Co., Philadelphia, Pa., died Dec. 21 from injuries received the preceding Friday in a motor accident in which another driver, in a fog, ran into his car from the rear, causing it to skid and crash into a tree. Mr. Ballinger was born in Petroleum Center, Pa., and secured his education at Drexel Institute. After service with Geissinger & Hales and with Hales & Ballinger, Mr. Ballinger in 1901 joined Emile G. Perrot in the firm of Ballinger & Perrot and in 1920, when this firm was dissolved, organized The Ballinger Co. These two firms specialized in the design of institutional and commercial building and industrial plants and their equipment. Mr. Ballinger was well known for his progressive work in the use of reinforced concrete in building design.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Wall Plaster, Wall Board, and Floor Composition

The Department of Commerce announces that, according to reports for the biennial census of manufactures, 1923, the establishments engaged primarily in the manufacture of wall plaster, wall board, and floor composition in that year reported products valued at $73,800,539, an increase of 46.9 per cent as compared with $50,226,758 in 1921, the last preceding census year. The value of the wall plaster produced was $37,825,147; of wall board, $20,627,408; of the floor composition, $3,455,906; and of all other products, such as putty, mortar, plaster lath, blocks, tile, etc. (and also probably including some wall plaster, wall board, and floor composition not specifically reported as such), $11,892,078.

Of the 196 establishments reporting for 1923, 41 were located in New York, 26 in California, 15 in Ohio, 13 in Michigan, 10 in Pennsylvania, 9 each in Illinois and Iowa, 7 in New Jersey, and the remaining 66 in 27 other states.

The statistics for 1923 and 1921 are summarized in the following statement. The figures for 1923 are preliminary and subject to such correction as may be found necessary upon further examination of the returns.

MANUFACTURE OF PLASTER, WALL BOARD AND FLOOR COMPOSITION

	1923	1921	Per Cent of Increase
Number of establishments	196	167	17.4
Wage earners (average number) (a)	9,288	6,979	33.1
Wages	$14,893,572	$9,839,237	51.4
Cost of materials (including fuel and containers)	$33,124,267	$25,168,902	31.6
Products, total value	$73,800,539	$50,226,758	46.9
Wall plaster	$37,825,147	(b)	....
Wall board, including plaster-board	$20,627,408	(b)	....
Floor composition	$3,455,906	(b)	....
Other products (c)	$11,892,078	(b)	....
Value added by manufacture (d)	$40,676,272	$25,057,856	62.3
Horsepower	63,210	(e)	....
Coal consumed (tons of 2,000 lbs.)	311,777	(e)	....

(a) Not including salaried officers and employees nor proprietors and firm members. Statistics for these classes will be given in final report.
(b) Not reported separately.
(c) Putty, mortar, plaster lath, blocks, tile, etc., and probably including some wall plaster, wall board, and floor composition not specifically reported as such.
(d) Value of products less cost of materials.
(e) Not reported.

Production of Lumber, Lath, and Shingles in 1923

The Department of Commerce announces that according to the data collected by the Bureau of the Census in co-operation with the Forest Service, Department of Agriculture, the production of lumber, lath, and shingles in the United States during 1923 was as follows:

Lumber 37,165,540 thousand feet b.m., an increase of 17.7 per cent as compared with 1922; lath, 3,328,013 thousands, an increase of 13.2 per cent; shingles, 7,506,869 thousands, a decrease of 7.7 per cent.

The lumber cut for 1923 in the West Coast states was the largest ever reported, and the total output for the United States was the largest since 1916.

The two predominating woods were Southern yellow pine, which contributed 34.8 per cent of the total production reported for the year, and Douglas fir, which contributed 22.1 per cent, their nearest competitor being Western yellow pine, with 7.5 per cent. With the exception of cypress, the cut of which decreased 5.7 per cent, all the principal species showed increases for 1923 as compared with the preceding year.

Exhibitors Association to Meet

According to an announcement just issued by Secretary Fred G. Hudson, the Highway Industries Exhibitors Association will hold a meeting at the Lexington Hotel, 2135 South Michigan Ave., Chicago, at 11 a.m., Wednesday, Jan. 7, during the week of the Good Roads Show. The association requests that each member company authorize a representative to act for it at this meeting with full voting power and that the secretary be advised of the name of this representative.

Business Notes

HUME CONCRETE PIPE CO., of Australia, is contemplating entering the American field. This company, which had headquarters at 301 Flinders Lane, Melbourne, Australia, was organized some twelve years ago for the manufacture of concrete pipe by the pouring process. Later it developed the centrifugal process of concrete pipe making so that at the present time it uses that process exclusively for pipe from 4 to 8 in. in diameter. It has at the present time 26 plants in operation in Australia and has extended into foreign countries, mainly in India, South America, and Europe quite extensively. The company has made plans for the starting of a test plant at Detroit, Mich., to illustrate its method of construction. The general manager of the company, T. S. Nettlefold, is in the United States at the end of an eleven months' tour of the world inspecting the various branch plants of the company.

SULLIVAN MACHINERY CO., Chicago, has recently opened a branch office and warehouse at 412 E. Third St., Los Angeles, with Benjamin P. Lane as local manager. A complete stock of air compressors, hammer drills, concrete breakers and air lift equipment will be carried.

MILBURN SALES CO., distributor in the Philadelphia territory for the Alexander Milburn Co., manufacturer of oxy-acetylene welding and cutting apparatus and portable carbide lights, has taken over the New York district as well, with headquarters at 309 Fifth Ave. E. P. Boyer and D. Keyser will be in charge of the new office.

HOLT MANUFACTURING CO., Peoria, Ill., announces that the Weber Implement & Automobile Co., distributor for Caterpillar tractors in St. Louis, having recently opened a Kansas City office, will henceforth include the western part of Missouri and the state of Kansas in the territory for which it acts as distributing agent. The Kansas City office will be under the management of R. R. Powers, formerly district manager of the Holt company, in that section.

GIBB INSTRUMENT CO., Bay City, Mich., has changed its name to Gibb Welding Machines Co. This denotes no change in organization but has been adopted as more exactly descriptive of the company's product.

COMPRESSED GAS MANUFACTURERS' ASSOCIATION will hold its twelfth annual meeting Jan. 26, at the Hotel Astor, New York City. This association represents manufacturers of all industrial gases, such as acetylene, ammonia, carbonic gas, chlorine, hydrogen, nitrous oxide, nitrogen, oxygen, sulphur dioxide and various hydrocarbon gases. These gases are used for isolated lighting and heating plants, in the fabrication of metal by means of the welding and cutting torch, for mechanical refrigeration, for carbonation of beverages, for bleaching in the textile and paper industries, in the purification of water and sewerage by chlorination, as anæsthetics, in fire extinction, and for various other purposes. The association studies principally the technical problems involved in the transportation of gases under pressure, the methods of insuring the establishment of safe practices, and the possibility of extending the uses of the compressed gases in industry.

T. L. SMITH CO., Milwaukee, Wis., manufacturer of concrete mixers, will give a dinner for its distributors and executives during the Road Show in Chicago. The dinner will be held at the La Salle Hotel, Monday evening, Jan. 5.

OSGOOD CO., Marion, Ohio, manufacturer of excavating machinery, an-

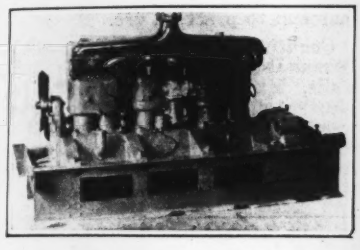
nounces the appointment of C. J. Thompson, as district sales manager of the New York territory, with headquarters at 50 Church St.

Equipment and Materials

Gas Engine for Heavy Duty

A new heavy-duty gasoline engine for use on equipment going into the general construction and quarry field, has recently been designed by the Beaver Mfg. Co., Milwaukee. This model operates at speeds from 800 to 1,000 r.p.m. and develops 130 hp. at 1,000 r.p.m. and 110 hp. at 800 r.p.m.

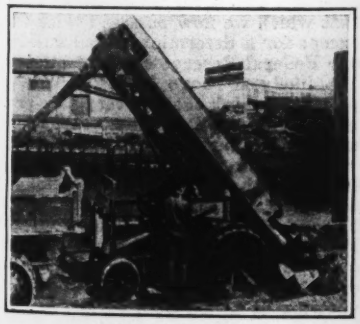
The engine is of the valve-in-the-head type; all moving parts are enclosed and dustproof. A force feed oiling system lubricates all main and connecting-rod bearings. The pistons and pins are lubricated from the splash. The engine is designed so that it can



be equipped with dual ignition, two spark plugs to each cylinder. It also has provision for standard electrical equipment and generator and starter.

Wheel Equipped Fordson Loader

Ability to propel itself into the pile while the elevator is in action is the feature of the new wheel equipped Fordson loader brought out by the

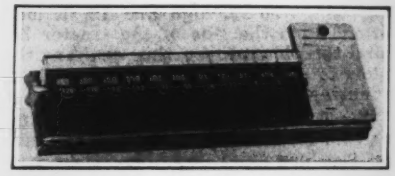


George Haiss Manufacturing Co., Inc., New York. This result is obtained by installing a cast steel take-off box between the flywheel and the clutch of the tractor. The tractor is disconnected in the center by taking the bolts out of the flywheel housing and installing the Haiss take-off box and attaching the rear end to the box. This operation puts the clutch in back of the take-off so that when it is desired to propel the machine into the pile, the elevator clutch is not disconnected

New Machine Aids Makeup of Contractors' Payrolls

As a time saver in making up contractors' payrolls a new machine, called the Denominator, has been devised by Frank H. Morse, treasurer of the Cranford Co., well known contracting firm of Brooklyn, N. Y. Its chief function is to indicate the number bills of required denominations, half dollars, quarters, dimes, nickels and cents which must be secured from the bank for inclosure in the pay envelope.

As shown in the accompanying illus-



tration, the machine is equipped with eleven keys, each designating a coin or bill from 1c. to $20. Each time any key is depressed one unit is recorded. A skilled operator will often depress two or three keys at a time. For example, an amount such as $17.35 requires only two operations, one for $10, $5 and $2 in the dollar column, and the other for the quarter and dime in the cents column. The machine provides a check on the payroll, for if the various amounts due employees are properly transferred to the Denominator, the addition of amounts on the currency slip should agree with the total of the payroll. The machine is being manufactured by the Denominator Adding Machine Co., 315 Eighth St., Brooklyn, N. Y.

Hand Power Pulling Jack

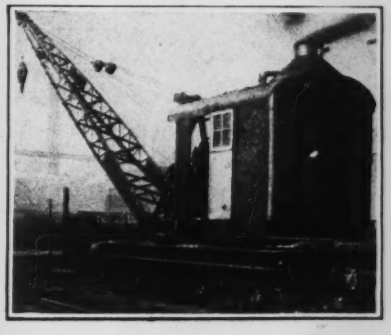
For a wide variety of uses in general construction and industrial service a hand-lever operated pulling jack, weighing 203 lb., and having a maximum direct pull of 12 tons at a rope speed of 3 ft. per minute, is offered by the Puller Manufacturing Co., Inc., New York. The device consists of a cable drum on a horizontal shaft mounted in a rugged steel frame, the latter being equipped, for portability, with a pair of wide tired metal wheels.

The machine is driven by a pawl and ratchet mechanism operated by a long handled lever, or, if desired, a crank. It is possible to rotate the drum either directly by the speed shaft or through a combination of gearing from a second power shaft, giving the operator a choice of six operating speeds. The speed shaft extends out from both sides of the frame to permit operation, when necessary, by two levers and four men. The equipment includes a brake band giving the operator control over the load. It is possible to change from pull to reverse or vice versa by shifting the position of a pawl reverse lever.

The pulling jack is 31 in. long, 18 in. wide and 18 in. high. It may be employed for such operations as: Pulling piles or well casing, tightening guy lines, moving heavy machinery, wrecking buildings, pulling stumps, pulling cable through ducts, spotting railway cars, handling pipe, setting large valves, cleaning sewers, and setting stone in masonry work.

Improved Features of 20-Ton Crane

An improved model of its No. 4 20-ton capacity locomotive crane has just been brought out by the Brown Hoisting Machinery Co., Cleveland. The principal changes consist of a high boom hitch, wide truck frame, extra



large diameter rotating ring and new contour of cab.

The crab has been simplified by the elimination of one shaft, thereby making the remaining parts more accessible. The drums are independently driven and free-running, with outside band clutches. The worm-gear boom hoist runs in an oil bath and this, with the high boom hitch, facilitates booming with loads.

Another innovation is the specially constructed wide truck frame with a center sill running the entire length, to which are fastened the friction-type draft gearings. In consequence of the wide truck-frame an extra large rotating ring is made possible which materially adds to the stability of the

crane. The load rollers that support the revolving superstructure are larger and are removed from above without jacking up the superstructure. The vertical rotating shaft can also be removed from above.

The cumbersome and unsightly counterweight device for retrieving the tag line and electric cable in grab bucket and magnet work has been discarded and in its place an arrangement both compact and novel has been installed. The main hoist shaft is extended through the crab far enough to accommodate a small drum and niggerhead, the latter being keyed to the shaft. The small drum, upon which the tag line or electric cable is wound, is rotatably mounted on the shaft and is driven by the niggerhead through a slip friction device.

Hand-Operated Finishing Machine

For finishing concrete roads the Heltzel Steel Form & Iron Co., Warren, Ohio, has placed on the market an improved hand-operated machine built in sizes for road widths of from 8 to 18 f

Two men are required to operate the device.

The mechanism is supported by a steel framework carried by four flanged wheels, two at each end which ride along the tops of the road forms. At the front end is the strike-off blade mounted on a pair of radius rods so that in moving back and forth there is produced a downward stroke of ¾ in., compressing the concrete under the blade. Behind the strike-off is a tamp to bring out excess water in the concrete and firmly pack the mix. An eccentric is provided for adjusting strike-off to the proper depth. At each end of the strike-off is a side guard to prevent concrete which piles up in front of the blade as the machine moves forward from running over the forms. The tamp is operated so that it can never strike the form. By means of a hinged extension the strike-off may be made to operate below the level of the tops of the forms on city paving with curbs.

For portability the finishing machine is fitted with removable transport wheels. Behind the tamp is a rubberized finishing belt. With a hand-operated machine, the manufacturer points out, the best results can be obtained when the concrete is of a consistency showing a slump of not less than 1 or more than 3 in.

Gear Drives—MESTA MACHINE CO., Pittsburgh, has just issued a 24-p. illustrated bulletin on its double helical cut teeth gear drive, used principally for the purpose of speed reduction.

Publications from the Construction Industry

Snow Plow—GOOD ROADS MACHINERY CO., INC., Kennett Square, Pa., describes its Champion V-type snow plow in an 11-p. illustrated bulletin. This plow is designed for attachment to a heavy 10-ton crawler tractor and consists of an inclined platform carried on runners with a V-type moldboard 8 ft. wide by 5 ft. high mounted on it. Accessory equipment consists of widening wings 30 in. high and 12 ft. long attached to the side of the tractor behind the plow proper, thus enabling the plow to clear a total width of 17 ft. of roadway.

Steel Windmill for Pumping—FAIRBANKS, MORSE & CO., of Chicago, have an 8-p. pamphlet describing their new Eclipse steel windmill for operating well pumps. The 8- or 10-ft. wheel drives a worm gear with connection to the pump pole, and by means of a special method of hanging the wheel it is automatically put out of operation during high winds. The gearing runs in a closed oil chamber.

Centrifugal Pumps—EARLE GEAR & MACHINE CO., Philadelphia, in a 31-p. illustrated booklet, features its line of centrifugal pumps adapted to all services except that of deep-well pumping. The pumps are of the double suction type with horizontal split casings; both suction and discharge openings are in the lower half casings to permit the complete dismantling of the pumps without disturbing the piping connections. All bearings are ring oiling. The range of sizes illustrated is from 4 to 14 in. discharge. The line includes both single stage and multi-stage units.

Power Shovels—OSGOOD CO., Marion, Ohio, presents in a 16-p. illustrated pamphlet a brief history of the Osgood Co. and its power shovels, covering a period of 52 years. The company's founder was Jason C. Osgood, of Troy, N. Y., who received his first letters patent on excavating machinery in 1846 and introduced the Osgood boom type dredge based on a patent dated 1872.

History of Cement—PORTLAND CEMENT ASSOCIATION, Chicago, has prepared an 11-p. illustrated pamphlet entitled "High Lights on the Portland Cement Industry," giving a concise history of the development of cement and the cement industry since 1824, when Joseph Aspdin first put the material to practical use.

Counting and Weighing Machines—INTERNATIONAL SCALE CORP., Chicopee Falls, Mass., is distributing a 12-p. illustrated bulletin on its counting and weighing machines for commodities consisting of similar parts or pieces. Another pamphlet describes multi-unit steel shelving for storerooms.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Fall of Prices Unlikely, Says Noted Economist

Professor Irving Fisher Points Out Danger of Inflation and Cut In Purchasing Power of Dollar

That the present price level is apt to stabilize at a point about 50 per cent above the pre-war basis or else rise to a new high peak, is the opinion of Professor Irving Fisher, of the Department of Political Economy, Yale University.

In the June 15, 1922 issue of *Engineering News-Record*, p. 1018, Prof. Fisher explained the illusory nature of the "back to normalcy" idea. He also expresses his belief that "the essence of normality in the price level is not a particular level of prices but constancy."

After two years and a half have elapsed, during which time prices have kept well above the pre-war level, we again hear from Prof. Fisher as follows:

To the Editor of *Engineering News-Record:*

In reply to your inquiry I will say that the opinions which I expressed in your issue of June 15, 1922, are substantially the same as those I would express today.

I then said "My own guess is that, in the immediate future, unless stabilization is achieved by appropriate legislation, we shall find prices rise for the next couple of years or so."

I think we may say that this expectation has been fulfilled.

I would say exactly the same thing today. With our large gold reserve and with a deposit expansion already adequate for a higher price level than that which we now possess I think that, except for a determined stabilization by our Federal Reserve administration, we are likely to have a further rise in prices. I think there is very little prospect of any fall, at least of any fall which shall be great and permanent.

We are now getting the benefit of an effort on the part of the Federal Reserve system to prevent inflation and deflation by suitable control of credit. The Federal Reserve banks are holding the great surplus of gold, ear-marked for eventual return to Europe, rather than allowing it to be used recklessly as a basis for credit expansion. To do this they need to keep great idle assets for the public good. This is an expensive procedure.

It may be that these efforts will fail either because they are too expensive to continue indefinitely or from sheer inability to control the situation.

If these efforts do fail we shall almost certainly have a very considerable inflation. Unless the demand for gold abroad should prove much greater than it now promises to be, such an inflation might readily in a few years

double our price level, that is cut the purchasing power of the dollar in two.

I do not predict that this will hapen, for, inasmuch as the efforts of the bankers to prevent such a result have been crowned with some success during the last two years, we may hope that they may continue to be equally successful in the future.

My guess at present, therefore, is that either we shall keep a stable price level at about fifty per cent above the pre-war price level or shall suffer from an inflation, first gradual and then rapid, ending in a level nearly double our present level.

I think these two possibilities are about equally likely and that any other possibility such as something between these two, or such as a fall of prices of any consequence, is extremely unlikely.

Very sincerely yours,
IRVING FISHER.

How the Contractor Sees 1925

The following is in reply to a letter from *Engineering News-Record* regarding the construction situation generally and in New England particularly:

"It is my opinion that 1925 will show a considerable increase in volume of building over 1924 and that this increased volume will, naturally, result in higher costs.

"Present indications are that every branch of the construction industry will be active in 1925. The election was followed immediately by a sharp optimistic tone in business, which, we believe, will continue and will eventually result in industrial expansion returning to at least normal proportions. The country is experiencing an unusual surge of educational requirements, which is reflected in more than ordinary volume of school and college expansion, which we believe will continue unabated for some time to come. Residential construction has not yet caught up with the demand, and there is no indication of a letup in this branch of building for another year at least. Mercantile construction usually follows industrial expansion fairly closely, and there will, doubtless, be a good volume of this class of building in 1925.

"The railroads appear to have turned a corner and already show indications of an effort to meet the requirements of the approaching business expansion. As large buyers of construction materials and equipment, the railroads are bound to affect the building situation through the maintenance of their properties. The forced liquidation of 1921 will not soon be forgotten by retailers and jobbers. Accordingly, a change in methods of distribution by manufacturers is likely to result in a considerable amount of storage and warehouse building during the coming season.

"For these reasons among others, I look for a large volume of construction and resulting higher building costs. As far as costs are concerned, it seems to be that the present level of costs should be considered as a new level rather than a high level. The published Aberthaw Index of costs of industrial building, using 1914 as the 100 basis, shows that, following the high point of 267 in 1920 and the subsequent sharp drop to about 150, building costs recovered to a point approximately 200, and that, for more than two years, the maximum variation from this level has been only four per cent. Within a few days, the price of steel and lumber has stiffened slightly, and special offerings and soft spots have disappeared; and this at a time when a seasonal decline might be expected. This increase is shown as a rise of one per cent on the Aberthaw Index for Dec. 1.

"As far as labor is concerned, several important labor agreements in New England expire in 1925; and I look to see these renewed at the same or slightly higher rates.

"Summarizing, I believe that 1925 will show a greater volume of construction, particularly in industrial lines, than at any time during the past four years; prices of building materials will, naturally, increase somewhat due to increased demand; and, for the same reason, labor costs and, perhaps, rates will increase slightly. I do not think the volume of construction will be sufficiently large to cause any labor shortage."

E. H. TEMPLE, JR.,
Vice-President,
Aberthaw Co.
27 School St., Boston, Mass.

THE CONSTRUCTION SITUATION IN THE NORTHWEST

The following is in reply to a letter from *Engineering News-Record* regarding the construction situation in the Northwest:

"We consider the outlook very favorable for work next year; taking the Northwest generally, which is the field we cover. Idaho, in particular, does not have a big volume of work in sight, although there is a fair measure of Federal reclamation work contemplated; one job being of considerable magnitude, and which will probably be under construction during 1925. There are two or three private irrigation projects of considerable size which will also be undertaken next season.

"The Union Pacific system has some double track work in prospect and will possibly make a line change at American Falls. There is very little road work in prospect in this state on account of lack of funds. We have one major industrial plant now up for bids which will involve perhaps $1,000,000. In Oregon there are at least two or three million dollar power developments which will be up for bids shortly. Indications appear favorable for considerable railroad betterments and some new branch line construction. It is understood the Southern Pacific will re-construct the line south of Klamath Falls to better meet the new construction now under way on the Natron Cut-off. Oregon figures to get one or two new Federal reclamation projects; this, however, is problematical.

"Oregon has a comparatively small amount of road funds available. Washington appears to have more road money than any of the other Northwestern states. At present there is at least two branch line railroad projects under consideration; on one of which bids are now being taken by the Northern Pacific.

"The building business is good on the coast and indications are that it will continue. Oregon and Washington both have several very large timber development projects which will, no doubt, go ahead next year. Nevada has more road work outlined, proportionately, than either Idaho or Utah, and inasmuch as it is largely financed by Federal money, will probably go through. Their work consists largely of grading and gravel or crushed rock surfacing.

"In Utah it is considered quite certain that the Union Pacific will complete a heavy section of double track east of Ogden. It is also expected that the D. & R. G. litigation and re-sale will permit betterments which are very badly needed on this line."

H. W. MORRISON,
Vice-President and
General Manager,
Morrison-Knudson Company.
802 Broadway, Boise, Idaho.

Large Projects In Prospect

The following represent just a few of the big engineering construction jobs on which bids are asked or will soon be called for. Further details are given in the Construction News section of this issue, pp. 333 to 342.

Proposed Work

Office and warehouse, Chicago, Ill., for Hibbard, Spencer, Bartlett & Co., $4,000,000.

Paper mill, Three Rivers, Que., for St. Lawrence Paper Co., Ltd., $3,000,000.

School, Springwells, Mich., for Board of Education, $2,000,000.

Hotel, Galveston, Tex., for G. K. Jorgensen, $1,500,000.

Water Supply, making survey, Enid, Okla., Black & Veatch, Kansas City, Mo., engrs., $1,500,000.

Warehouse, Milwaukee, Wis., M. Tullgren & Sons, archts. and engrs., $1,500,000.

Chapel, Chicago, Ill., for University of Chicago, $1,000,000.

Factory, Alliance, O., for McCaskey Register Co., $1,000,000.

Sugar Factory, Sydney, Mont., for Holly Sugar Corp., $1,000,000.

Court House, Kansas City, Kan., for Wyandotte County, $1,000,000.

School, Bridgewater, Mass., for Department of Education, $750,000 to $1,000,000.

Sewage disposal plant, Cleveland, O., plans prepared, $3,500,000.

Hotel, Kansas City, Mo., plans prepared, $1,200,000.

Bids Wanted on Big Jobs

Hotel, Chicago, Ill., for Stevens Hotel Co., $20,000,000.

Bridge, Redwood City, Calif., Dumbarton Highway Bridge Corp., San Francisco, $2,000,000.

Bank and office building, for Central National Bank, $1,000,000.

Large Contracts Let During Week

Generating station, Cleveland, O., to American Bridge Co., New York, N. Y., $10,000,000.

Office building, New York, N. Y., to Dwight P. Robinson & Co., Inc., $5,000,000.

Municipal development, Bogota, Colombia, S. A., to Ulen & Co., $3,500,000.

Sewer, Brooklyn, N. Y., to P. J. Carlin Constr. Co., N. Y. C., $3,252,124.

Steel water mains, Detroit, Mich., to M. R. Hanna, $1,116,545.

Apartment hotel, Santa Monica, Calif., to Trewhitt-Shields, Los Angeles, $1,000,000.

Apartment, New York, N. Y., to G. A. Fuller Corp., $1,000,000.

Steel Demand Increasing—Cement Shipments Slower

The decrease in demand for cement, though seasonal, is in direct contrast with the present activity in steel buying.

About this time of the year, production and shipments at the cement mills are usually slower than during the third quarter. The natural result of this process is increased reserve stocks at the mills. Cement, therefore, may be said to be following its regular seasonal trend.

Judging the steel demand from the amount of unfilled orders on books of the U. S. Steel Corporation on the last day of each month, the trend has been upward since July of this year. During the corresponding period in 1923, the trend was exactly in the opposite direction. Steel, therefore, is showing an unseasonal activity in demand. Since enlarged mill capacity and prompt handling by railroads, serve to prevent any price advances arising out of scarcity, the only factor remaining that could cause higher steel prices is a protracted buying movement. There has been no actual advance in mill prices of steel structurals since the second week in December as shown by the table on p. 333 of this issue.

A protracted buying movement is not expected at this time, inasmuch as most of the current demand consists of released orders that were being held back because of election uncertainties.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of December 4, the next, on January 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.34	+$3.90	$4.15	$3.10	$3.35	$4.00	$3.00	$3.35	$4.25
Structural rivets, 100 lb.	3.75	+4.45	4.75	3.75	3.75	4.65	5.00	3.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.24	+3.40	3.38	2.60	3.25	3.97½	3.35	3.25	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	54.2%	43%	53%	55.45%	36%	44.7@55.5%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	55.60@56.60	56.00	56.00	47.20@48.20	55.50	64.00	—53.00	65.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.20	2.42	2.84	2.61	2.65	1.80
Gravel, ¾ in., cu.yd.	2.00	1.90	2.38	2.75@3.00	1.65	1.90	2.15	1.50	1.25
Sand, cu.yd.	1.00	1.40	2.00	2.75@3.00	1.25	1.00	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd.	1.85	2.00	2.83	2.75@3.00	1.75	2.50	2.15	3.00	2.25
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	58.00	34.00	57.20	55.00	39.75	+50@53	29.00	26.00	60.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	23.00	24.00	22.00	24.00	21.00
Lime, common, lump, per bbl.	2.50@3.00	1.45	1.85	1.50	1.35	2.70	1.60	2.80	10.50
Common brick, delivered, 1,000	18.00	10.50	12.10	12.00	15.00	12.00	14.50	14.50	17.50
Hollow building tile, 4x12x12, per block	Not used	.1004	.0941	.089	.07	.085	.....	.11	.12
Hollow partition tile 4x12x12, per block	.1162	.1004	.0941	.089	.....	.085	.108	.11	.10
Linseed oil, raw, 5 bbl. lots, gal.	+1.17	+1.23	+1.28	1.10	+1.25	+1.50	1.18	1.12	1.11
Common Labor:									
Common labor, union, hour	.75	.30	.....	.82½	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.60	.75	.50@.55	.35@.50	.50	.50	.25@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers, 75c.; excavating laborers, 62½c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.60 for Kelly Island and Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 99.62). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $37.83.

Conditions Affecting the Market

Steel, linseed oil and lumber are the three most active items on this week's list of price changes in the building materials market.

In the general commodities market, that is, materials not specially related to construction, price advances are in excess of declines.

Advances in the principal heavy rolled steel products and rivets are more noticeable in the South. Fir timbers are higher, this week, in the West. The rise in linseed oil ranged from 2 to 3c. per gal. over the entire country, beginning a week ago. Red and white lead advanced ½c. per lb. during the week of Dec. 18.

Steel mills are now operating at about 80 per cent of capacity as against 72 per cent last month, 60 per cent two months ago and about 40 per cent in mid-summer.

The increased steel demand is unseasonal and is probably the result of anticipated price advances rather than fear of slow mill deliveries.

The U. S. Department of Commerce reports substantial gains in bookings of steel structurals and commercial steel castings. Another good indication of sustained interest in building, is the increase in jobbers' orders for plumbers' supplies. The Department of Commerce index of wholesale prices of plumbing fixtures has shown a steady decline since June of this year.